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Public Roads

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Travel on main rural roads increased 24 percent from 1950 to 1954

Public Roads

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Traffic and Travel Trends, 1954

BY THE HIGHWAY TRANSPORT RESEARCH BRANCH
BUREAU OF PUBLIC ROADS

Reported by THOMAS B. DIMMICK
Head, Current Data Analysis Unit

In keeping with the prime significance of highway transportation, this article discusses the growth in traffic volumes carried on rural roads and city streets by vehicle types, and presents more detailed data than were available heretofore. Material received from the several State highway departments in connection with the major highway studies of 1954 has made it possible to establish new benchmarks from which more accurate estimates of future travel and traffic trends can be based.

A comparison of rural and urban travel in 1954 shows the following highway usage: rural, 56.6 percent; and urban, 43.4 percent. In 1948, the division was about equal. Since 1949 truck travel in rural areas has increased at a faster rate than in urban areas, and passenger cars have exceeded that rate. On the other hand, truck travel in urban areas gained more rapidly than did that of passenger cars. Travel by all types of vehicles on all roads and streets increased more than 22 percent since 1950.

The growth of travel on all roads and streets by trucks and truck combinations for the period 1940–54 far exceeds that for passenger cars and buses. Truck travel increased 112 percent; passenger cars, 81 percent; and buses, 65 percent.

With the exception of the war years and a few years thereafter, the trend of total travel follows closely the economic trend as represented by the Gross National Product. Preliminary estimates of travel for 1955 indicate an increase of 4.6 percent over the previous year.

Average daily travel on all rural roads in 1954 was 869 million vehicle-miles compared with 845 million in 1953, a 2.9 percent increase. Travel on main rural roads in 1954 was 98 percent above 1940; passenger-car mileage was up 93 percent; while truck and truck-combination travel increased 116 percent.

The weights of single-unit trucks, loaded or empty, have increased only about 10 percent from 1936 to 1954. Truck-combination weights increased rather steadily throughout the period—loaded weights being some 61 percent greater and empty weights about 73 percent greater in 1954 than in 1936. Ton-mileage hauled in single-unit trucks increased from 14.3 billion in 1936 to 36.6 billion in 1954. For truck-combinations, ton-mileage increased from 13.7 billion in 1936 to 107.3 billion in 1954. In 1950, 18.5 percent of the truck and truck-combination travel was by two-axle tractors pulling single-axle semitrailers, while travel by the same type of tractor with dual-axle semitrailers amounted to only 9 percent. By 1954 this relation had changed materially, the dual-axle semitrailers being considerably more numerous. In 1954, the four-axle combinations also accounted for a larger portion of the ton-mileage than any other single vehicle type, whereas in 1950 the three-axle combinations predominated.

This change is reflected in axle loads. The frequency of axles weighing 18,000 pounds or more in 1950 was over seven times that in 1936, but from the 1950 high there was a consistent yearly drop which amounted to 35 percent by 1954. The frequencies for 20,000- and 22,000-pound axles decreased more than one-half during the same period. While the frequency of loads exceeding State legal limits by 5 percent changed little, there appears to be a real reduction in the percentage of higher overloads. Overloads of 50 percent were rare after 1951, and overloads of 20 to 50 percent declined noticeably.

THE ever-increasing importance of our highways in the movement of persons from point to point and of goods from producer to consumer makes a thorough knowledge of such movements, their volumes, present trends, and potential future levels of great interest and importance to persons engaged in transportation studies or in the design of traffic facilities.

In the 5-year period beginning in 1936 (mostly in 1936 and 1937), 47 of the 48 States in cooperation with the Bureau of Public Roads conducted surveys for a 12-month period to collect data which would supply comprehensive information concerning vehicle characteristics and travel habits. The measuring of road mileages, the counting of traffic by vehicle type, the weighing of trucks on rural roads, and the questioning of drivers concerning origin and destination and miles driven on different road systems during the preceding year supplied basic data from which a vast amount of information regarding travel habits, ton-miles hauled on rural systems, and vehicle-miles driven on all systems could be calculated for the period of the survey.

Since the original surveys, the States have operated automatic traffic recorders at a large number of locations and have adopted other continuing operations which provide sufficient data for estimating trends in traffic volumes. Periodic weighing operations, combined with manual classified counts of all vehicles passing the weighing stations, have been made which provide information concerning vehicle types and weights as well as their loading habits. By means of these trends, annual estimates were published showing for each year the travel on rural roads from 1936 to 1952 and on city streets from 1936 to 1948.[1] By combining carried load data with vehicle-mileage figures, the ton-mileage of freight hauled on main rural roads was estimated for each year. Sufficient data are not available to justify publishing estimates of ton-mileage carried on local roads. No data are available concerning loads carried on city streets and no attempt has been made to estimate the amount of this haulage.

Between 1946 and 1950, estimated volumes of total urban and rural travel from 1936 to 1948, inclusive, were published annually in PUBLIC ROADS. These estimates were based on comprehensive statewide traffic surveys made in the 1936–37 period, and were adjusted each year by the use of variable indices such as motor-fuel consumption and motor-vehicle registration. Following the issuance of the 1948 data, it became apparent that significant changes in factors affecting travel had occurred. The decision was made at that time to discontinue publishing the series until the States had collected a sufficient body of current data on urban travel.

Urban Travel Data Improve

Many States now have adopted some plan of observing the trends in urban travel either by means of continuous or part-time counts, and several have made sufficient counts to enable them to estimate accurately vehicle-miles of travel on the streets of their key cities. Most States are now able to report the average daily travel on the urban extensions of State highway systems and other arterial streets of their cities, and to estimate with a reasonable degree of accuracy the travel on all of the streets.

Although approximations may have to be made concerning the lightly traveled local streets, a large expenditure of funds to determine accurately the amount of travel on them is not justifiable. Motor-vehicle-use surveys, made in several States in recent years, have

[1] See previous articles on traffic in PUBLIC ROADS: vol. 27, Nos. 6 and 11; vol. 26, Nos. 5 and 11; vol. 25, Nos. 3, 7, and 12; vol. 24, No. 10; and vol. 23, No. 9.

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Table 1.—Estimate of motor-vehicle travel in the United States by vehicle types, 1949–54

Vehicle type	Travel in millions of vehicle-miles for calendar years—					
	1949	1950	1951	1952	1953	1954
Passenger cars: [1]						
Rural travel	168,897	181,095	205,375	222,064	237,567	246,300
Urban travel	173,581	182,518	186,756	188,123	197,784	204,305
Total	342,478	363,613	392,131	410,187	435,351	450,605
Commercial buses:						
Rural travel	1,470	1,394	1,381	1,444	1,455	1,453
Urban travel	2,030	1,877	1,822	1,750	1,856	1,743
Total	3,500	3,271	3,203	3,194	3,311	3,196
School and nonrevenue buses:						
Rural travel	677	729	823	1,026	1,024	1,091
Urban travel	75	81	92	114	114	121
Total	752	810	915	1,140	1,138	1,212
All buses:						
Rural travel	2,147	2,123	2,204	2,470	2,479	2,544
Urban travel	2,105	1,958	1,914	1,864	1,970	1,864
Total	4,252	4,081	4,118	4,334	4,449	4,408
All passenger vehicles:						
Rural travel	171,044	183,218	207,579	224,534	240,046	248,844
Urban travel	175,686	184,476	188,670	189,987	199,754	206,169
Total	346,730	367,694	396,249	414,521	439,800	455,013
Trucks and combinations:						
Rural travel	48,053	56,780	60,843	64,929	68,329	68,374
Urban travel	29,678	33,772	34,001	34,131	36,304	37,470
Total	77,731	90,552	94,844	99,060	104,633	105,844
All motor vehicles:						
Rural travel	219,097	239,998	268,422	289,463	308,375	317,218
Urban travel	205,364	218,248	222,671	224,118	236,058	243,639
Total	424,461	458,246	491,093	513,581	544,433	560,857

[1] Includes taxicabs.

provided additional data concerning travel on all types of city streets. While much is desired in the way of more complete urban travel data for the major thoroughfares, considerable progress is being made in the collection of this information.

New Travel Trend Base Established

The Federal-Aid Highway Act of 1954 directed that a study be made of the costs of completing the several systems of highways in the several States. One important result of the States' cooperation in this study was a complete estimate of vehicle-miles of travel in 1953 on all systems, urban as well as rural. These State estimates, based on the best available data regarding current travel on the various systems of roads and streets, now make it possible to establish a new base for national vehicle-mileage estimates.

The new vehicle-mile totals check closely with those previously calculated from trend data since 1948. The new main rural road figure is only a small fraction of one percent larger than the old trend figure. Somewhat larger discrepancies were found between the old and new local rural road and urban street estimates although the totals are practically the same. In fact, the new total vehicle-mileage estimate exceeded the old trend total by only 0.4 of one percent. Such close concurrence of the two estimates indicates that the plan of adjusting vehicle-mileage figures by means of trends is satisfactory for the main highway systems, provided the estimates are checked periodically to adjust for the mileage changes that occur.

Urban Travel Estimates Extended

Since the 1953 vehicle-mileage total compared so favorably with the figure derived from the State reports, all estimates for the years 1949–54 have been adjusted to remove the discrepancy indicated by the 1953 check. Table 1 gives the estimated travel in millions of vehicle-miles by passenger cars, commercial buses, school and nonrevenue buses, and trucks on rural roads and on urban streets for the 6 years commencing with 1949 when publication of urban travel estimates was discontinued. A comparison of the figures indicates that truck travel is increasing at a faster rate in rural areas than in urban. At the same time, travel by passenger cars is increasing even faster on rural roads than truck travel. Conversely, truck travel on urban streets is increasing faster than passenger-car travel. Commercial-bus travel, both rural and urban, is decreasing while school bus travel is rapidly increasing. Total travel has increased over 22 percent in the 4 years since 1950.

Travel Follows Economic Trend

Travel on all rural roads and streets, motor-vehicle registration, motor-fuel consumption, and the Gross National Product are shown in figure 1 for the years 1936–54, inclusive, as a percentage of the 1950 values. This chart indicates that, with the exception of the war years and a few years thereafter when traffic restrictions drastically curtailed travel while production was stimulated, the trend of total travel follows closely the economic trend as represented by the Gross National Product.

Immediately following the war, the Gross National Product declined and then leveled off while traffic increased rapidly. The curves came together again in 1949 and followed closely until 1954. The downward trend of production in 1954 (which proved to be only temporary) was reflected only slightly in highway travel; the rate of increase was 3 percent from 1953 to 1954 compared with 6 percent from 1952 to 1953. The volume of truck travel in 1954, however, was only 1.2 percent above the previous year's total and ton-mileage hauled in 1954 was 2 percent less than in the previous year. Preliminary estimates of travel and Gross National Product for 1955 indicate that both quantities will be about 4.6 percent greater than in the previous year.

Figure 2 shows traffic volumes on rural roads and urban streets for each of the years 1936–54, as a percentage of such travel in 1950. It is noticeable that from 1936 to 1948 the curves representing rural roads and urban streets are very similar. From 1948 on, however, rural travel increased at a fairly uniform rate with only a slight indication of leveling off, while urban travel increased each year but at a much reduced rate, which resulted in a considerable spread between the two curves. The past year was an exception to the general

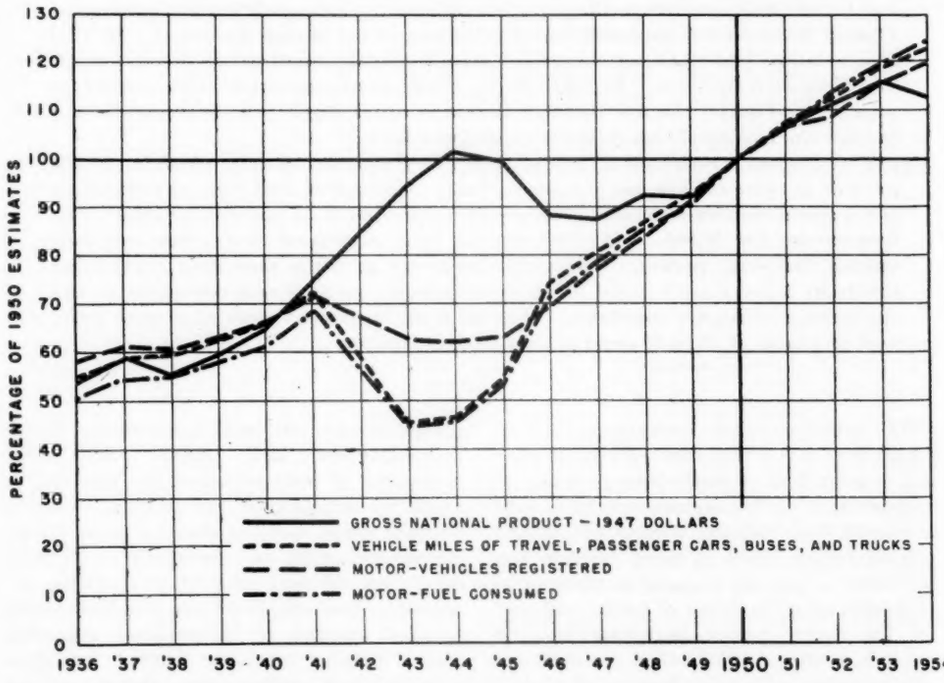

Figure 1.—Total travel, motor-vehicle registration, motor-fuel consumption, and Gross National Product, 1936–54, as a percentage of the respective amounts in 1950.

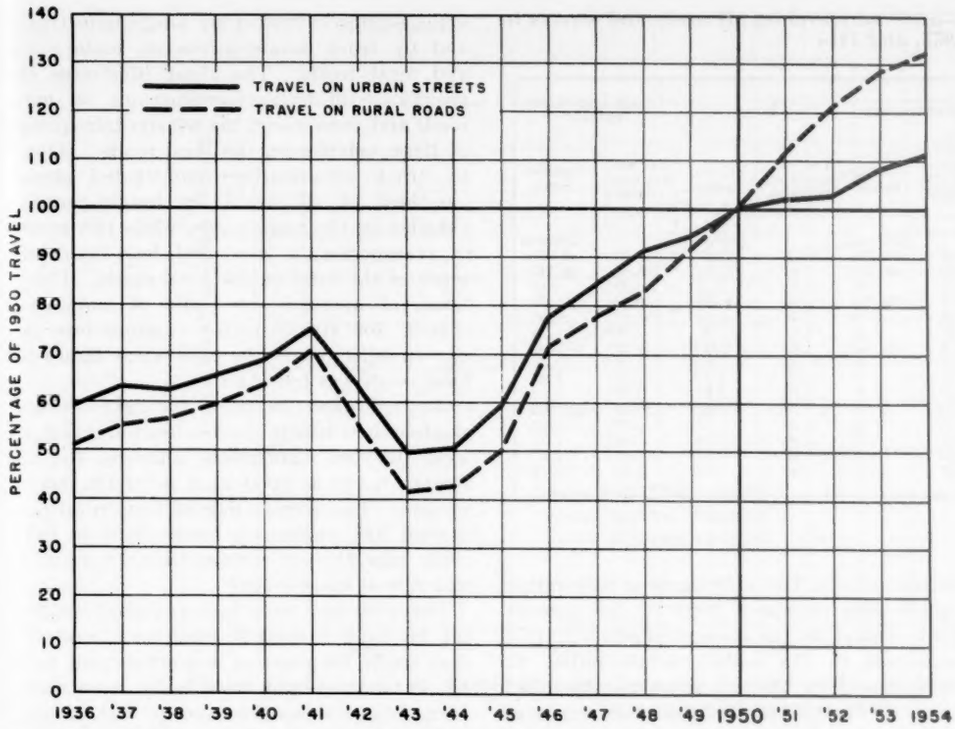

Figure 2.—Travel on all rural roads and streets, 1936–54, as a percentage of such travel in 1950.

trend that prevailed from 1948 through 1953, since in 1954 urban travel increased 3.2 percent while rural travel increased only 2.9 percent. This difference is small and probably of little significance.

In 1948 and previous years for which estimates were made, the total volumes of urban and rural travel were approximately equal. For instance, the 1936 estimates indicated that rural traffic accounted for 48.66 percent of all travel, while in 1948 the figure was 49.97 percent. Since 1948, rural travel has exceeded urban travel to an increasing degree. The relation of rural travel to total travel in the succeeding years was as follows: 51.62 percent, 1949; 52.37 percent, 1950; 54.66 percent, 1951; 56.36 percent, 1952; 56.64 percent, 1953; and 56.56 percent, 1954.

Table 2 shows the estimated amounts of travel in 1954 on main rural roads, local rural roads, and urban streets for passenger cars, buses, and trucks together with the number of vehicles registered and the quantity of motor fuel consumed. The travel figures were obtained by applying the available trends to the 1953 data, which, as previously stated, were derived from the various State reports submitted for the nationwide highway study.

In general, the table is comparable to the one compiled for a study made in 1948.[2] In addition to traffic volumes and data concerning vehicles registered and motor fuel consumed, table 2 shows average miles of travel per vehicle, average consumption of motor fuel per vehicle, and average travel per gallon of fuel consumed. One feature to be found in this table, and not included in the 1948 study, is the segregation of travel data on main roads and local roads.

A comparison of vehicle-miles of travel on all roads and streets in 1940, 1945, 1950, 1953, and 1954 is given in table 3. Probably the most significant relation shown by this table is the greater increase of travel by trucks and truck combinations in comparison with passenger cars and buses until 1950. Travel by trucks and truck combinations in 1954 was 112 percent greater than in 1940. The total increase for passenger-car travel during the period was 81 percent. Bus travel leveled off considerably and only a 65-percent gain is indicated for this period. The percentage of all rural and urban travel by trucks and combinations increased from 16.52 percent in 1940 to 18.87 percent in 1954.

Rural-Road Travel Increases

Figure 3 shows the annual vehicle-miles of travel on all rural roads by 12-month periods ending each month (moving average) from the end of 1936, the first year of the planning surveys, to the present. This method of presentation reduces the seasonal fluctuations. The portion of the curve from the end of 1946 through 1950 indicates that the increases averaged over 10 percent each year and was almost 12 percent during 1951. During 1952 and 1953, the annual increases were about 7 percent and in 1954, the increase dropped to 3 percent. Reports for the first half of 1955 indicate an increase of 4 to 5 percent for the calendar year.

Travel on all rural roads in the eastern, central, and western regions of the country,[3] by 12-month periods ending each month, is shown in figure 4 as a percentage of such travel in 1950. Since 1950, traffic has consistently increased more in the eastern regions than in other sections of the country which is the reverse of what occurred from 1941 to 1950.[4] In the western regions, traffic increased slowly in 1951 but sharply reduced the eastern lead in 1952 and 1953, while in 1954 the trend was similar to that in the eastern regions and only slightly lower. Travel in the central regions followed a trend below those of either the eastern or western regions, but made an

[2] *Trends in motor-vehicle travel, 1948*, by G. P. St. Clair. PUBLIC ROADS, vol. 25, No. 12, Feb. 1950, p. 296.

[3] *Eastern regions.*—New England: Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, and Vermont. Middle Atlantic: New Jersey, New York, and Pennsylvania. South Atlantic: Delaware, Florida, Georgia, Maryland, North Carolina, South Carolina, Virginia, and West Virginia. *Central regions.*—East North Central: Illinois, Indiana, Michigan, Ohio, and Wisconsin. East South Central: Alabama, Kentucky, Mississippi, and Tennessee. West North Central: Iowa, Kansas, Minnesota, Missouri, Nebraska, North Dakota, and South Dakota. West South Central: Arkansas, Louisiana, Oklahoma, and Texas. *Western regions.*—Mountain: Arizona, Colorado, Idaho, Montana, Nevada, New Mexico, Utah, and Wyoming. Pacific: California, Oregon, and Washington.

[4] *Trends in traffic volumes, vehicle types, and weights*, by Thomas B. Dimmick. PUBLIC ROADS, vol. 27, No. 11, Dec. 1953, p. 236.

Table 2.—Estimate of motor-vehicle travel in the United States by vehicle types in calendar year 1954

Vehicle type	Motor-vehicle travel					Number of registered vehicles [1]	Average travel per vehicle	Motor-fuel consumption		Average travel per gallon of fuel consumed
	Main rural road travel	Local rural road travel	Total rural travel	Urban travel	Total travel			Total [2]	Average per vehicle	
	Million vehicle-miles	*Million vehicle-miles*	*Million vehicle-miles*	*Million vehicle-miles*	*Million vehicle-miles*	*Thousands*	*Miles*	*Million gallons*	*Gallons*	*Miles/gal.*
Passenger cars [3]	169,755	76,545	246,300	204,305	450,605	48,413	9,308	30,915	639	14.58
Buses:										
Commercial	1,148	305	1,453	1,743	3,196	83	38,506	639	7,699	5.00
School and nonrevenue	603	488	1,091	121	1,212	150	8,080	116	773	10.45
All buses	1,751	793	2,544	1,864	4,408	233	18,918	755	3,240	5.84
All passenger vehicles	171,506	77,338	248,844	206,169	455,013	48,646	9,354	31,670	651	14.37
Trucks and combinations	45,553	22,821	68,374	37,470	105,844	9,726	10,883	12,541	1,289	8.44
All motor vehicles	217,059	100,159	317,218	243,639	560,857	58,372	9,608	44,211	757	12.69

[1] Registration figures differ slightly from those in Bureau of Public Roads table MV–1 for 1954 because of adjustments for defective classification in a few States and to allow for duplicate registrations.

[2] Total fuel consumed differs from that given in Bureau of Public Roads table G–21 because of adjustments to cover estimated amounts used by motorcycles.

[3] Includes taxicabs.

Table 3.—Comparison of the estimated vehicle-miles of travel on all roads and streets in 1940, 1945, 1950, 1953, and 1954

Year	All vehicles, vehicle-miles	Passenger cars		Buses		Trucks and combinations	
		Percentage of all vehicles	Vehicle-miles	Percentage of all vehicles	Vehicle-miles	Percentage of all vehicles	Vehicle-miles
	Millions		*Millions*		*Millions*		*Millions*
1940	302,188	82.60	249,604	0.88	2,657	16.52	49,927
1945	250,173	80.02	200,199	1.53	3,832	81.45	46,142
1945: 1940 ratio	*.83*	*.97*	*.80*	*1.74*	*1.44*	*1.12*	*.92*
1950	458,246	79.35	363,613	.89	4,081	19.76	90,552
1950: 1945 ratio	*1.83*	*.99*	*1.82*	*.58*	*1.06*	*1.07*	*1.96*
1950: 1940 ratio	*1.52*	*.96*	*1.46*	*1.01*	*1.54*	*1.20*	*1.81*
1953	544,433	79.96	435,351	.82	4,449	19.22	104,633
1953: 1950 ratio	*1.19*	*1.01*	*1.20*	*.92*	*1.09*	*.97*	*1.16*
1953: 1945 ratio	*2.18*	*1.00*	*2.17*	*.54*	*1.16*	*1.04*	*2.27*
1953: 1940 ratio	*1.80*	*.97*	*1.74*	*.93*	*1.67*	*1.16*	*2.10*
1954	560,857	80.34	450,605	.79	4,408	18.87	105,844
1954: 1953 ratio	*1.03*	*1.00*	*1.04*	*.96*	*.99*	*.98*	*1.01*
1954: 1950 ratio	*1.22*	*1.01*	*1.24*	*.89*	*1.08*	*.95*	*1.17*
1954: 1945 ratio	*2.24*	*1.00*	*2.25*	*.52*	*1.15*	*1.02*	*2.27*
1954: 1940 ratio	*1.85*	*.97*	*1.81*	*.90*	*1.65*	*1.14*	*2.12*

average annual gain over the period of about 6.5 percent.

The average daily vehicle-miles of travel on all rural roads by months in 1953, 1954, and the first 8 months of 1955 are shown graphically in figure 5. The graph shows that travel in 1954 was generally heavier month by month in all regions than it was in the previous year, except in the western regions during June. Likewise for the first 8 months of the year, travel in 1955 exceeded that in 1954 each month except in the central regions in February and in the western regions in April.

The average daily travel on all rural roads in the United States in 1953 was 845 million vehicle-miles. The 1954 figure of 869 million vehicle-miles exceeded 1953 by 2.9 percent. Daily travel in the eastern regions in 1953 amounted to 278 million vehicle-miles. In 1954, travel in these regions increased 3.2 percent over the previous year and amounted to 287 million vehicle-miles. In the central regions, the average daily travel in 1953 was 414 million vehicle-miles. This figure was increased 2.2 percent in 1954 and amounted to 423 million vehicle-miles. In the western regions, travel in 1953 amounted to 153 million vehicle-miles daily, and increased 3.9 percent in 1954, or to 159 million vehicle-miles.

Figure 6 shows, in bar-chart form, the vehicle-miles of travel by single-unit trucks and by truck combinations on main roads and local roads. The chart illustrates the prevalence of truck combinations on main roads and, conversely, the relative infrequence of these vehicles on the local roads. Travel by truck combinations constituted almost one-third of all travel by freight-carrying vehicles on the main roads, while this means of transportation composed less than one-tenth of the total on the local roads. Put in terms of averages, one mile of main road carried 106 tractor-trailer combinations per day in 1954, while the equivalent figure for local roads was less than 3.

Average daily traffic by the lighter-weight single-unit trucks is also far less important on local than on main roads, although the difference is not as great as it is for the combinations. The average mile of main rural road carried 228 single-unit trucks daily in 1954, while only 21 such vehicles traveled the average mile of local road.

Very few data have been collected concerning the loads carried on local roads, and current traffic information concerning this mileage is not as reliable as it is for main roads. Local road mileage far exceeds that of main roads, yet estimates indicate that total truck travel on main roads was more than double and ton-mileage hauled was about four times the amount carried on local roads. Because of a scarcity of basic and trend data and the relative unimportance of the local road mileage from a freight-carrying standpoint, subsequent sections of this article will be confined to data concerning travel and freight transported on main rural roads.

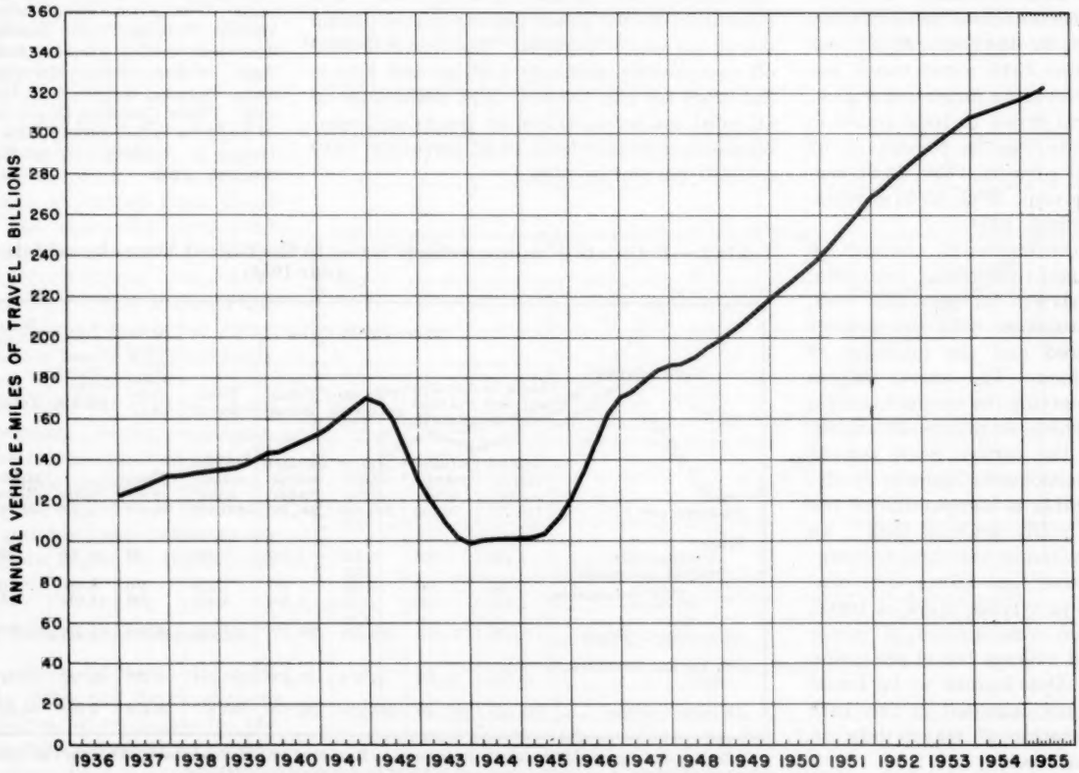

Figure 3.—Vehicle-miles of travel on all rural roads by 12-month periods ending each month, 1936 to mid-year 1955.

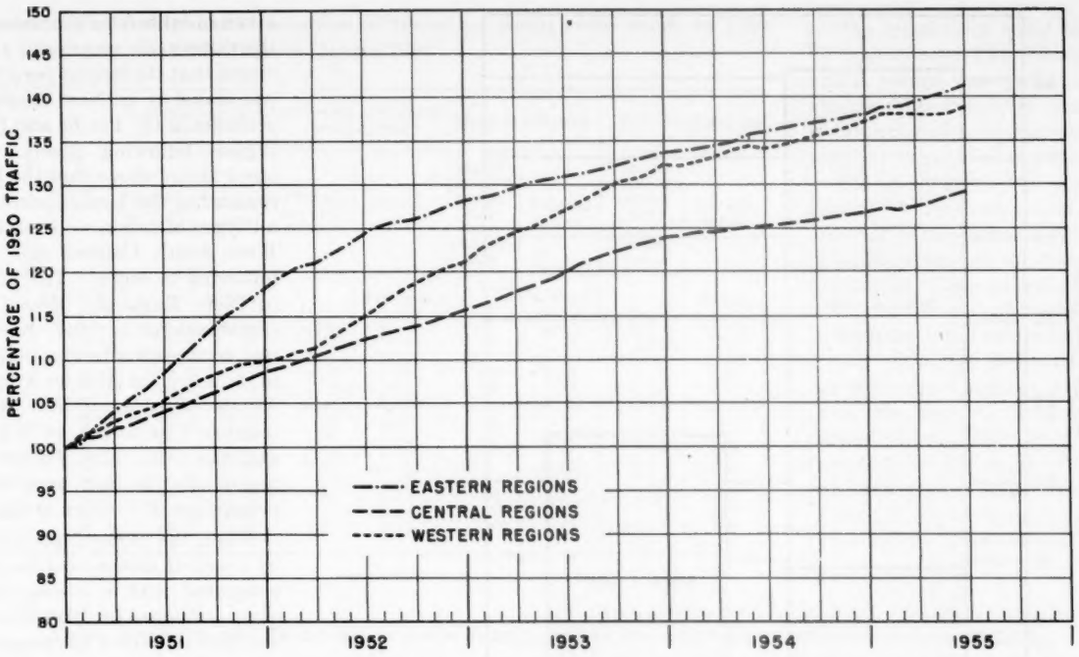

Figure 4.—Travel on all rural roads by 12-month periods ending each month, 1951 to mid-year 1955, as a percentage of travel in 1950.

Main Rural-Road Travel Continues Upward Trend

Travel by passenger vehicles, single-unit trucks, and tractor-trailer combinations on main rural roads from 1936 to 1954, inclusive, as a percentage of such travel in 1950 is shown in figure 7. Probably the most interesting and important trend is the increase in the popularity of combination-type vehicles between 1941 and 1950. From 1936 to 1941, the use of combinations was increasing at about the same rate as that of the other types of vehicles. During the war, however, the greater operating efficiency of combinations was recognized and their travel was curtailed only slightly, whereas travel by other types of trucks was reduced greatly. After the war ended, the use of combinations increased rapidly.

The 1950 surveys indicated a gain of almost 24 percent over the previous year for combination vehicles, whereas the use of single-unit trucks increased only 11 percent in the same period. Since 1950 the trends in use of combinations and of single-unit trucks have been very similar and have not climbed as fast as the trend for passenger-car use. For the entire period from 1936 to 1954, inclusive, annual travel of passenger cars increased 135 percent; single-unit trucks, 149 percent; and tractor-trailer combinations, 425 percent.

Table 4 compares the estimated vehicle-miles of travel on main rural roads in 1940, 1945, 1950, 1953, and 1954, and gives the percentage distribution of this travel by main vehicle types. The table shows that total travel in 1954 was 98 percent greater than it

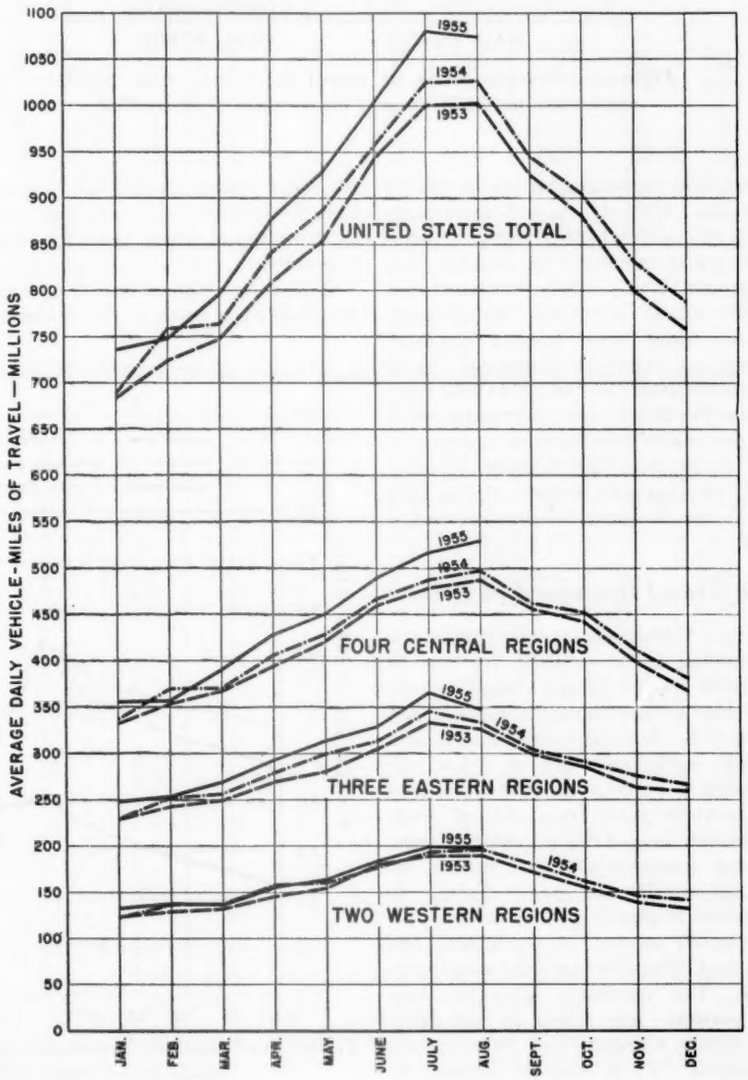

Figure 5* (Right).—*Average daily travel on all rural roads in 1953, 1954, and the first 8 months of 1955.

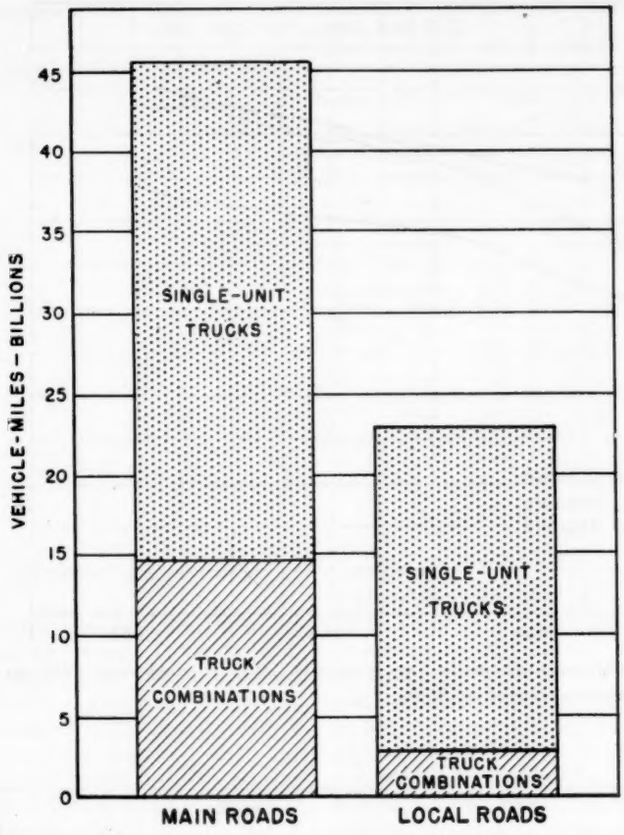

Figure 6.—Vehicle-miles of travel by trucks and truck combinations on main and local rural roads in 1954.

was in 1940, that passenger-car travel was 93 percent greater, while truck and truck-combination travel increased 116 percent. Single-unit truck travel increased 86 percent (less than passenger cars), while tractor-trailer combination travel increased 229 percent. Other ratios listed show greater increases for combinations than for single-unit trucks in each instance except in the 1954:1953 comparison. In the latter case both ratios show a slight decrease—combinations decreasing somewhat more than the smaller vehicles. This would be expected in light of the 1954 decline in Gross National Product previously mentioned.

Truck Travel Decreased in 1954

The ratios of 1954 traffic on main rural roads to corresponding traffic in 1953, by type of vehicle and by United States Census regions and the three main geographic regions, are given in table 5. For the United States as a whole, while local passenger-car travel increased about 4 percent in 1954 compared with the previous year, travel by all other types of vehicles (out-of-State passenger cars, trucks, truck combinations, and buses) decreased. Apparently the 1954 decline in Gross National Product affected tourist passenger-car travel as well as truck and bus travel, but had little effect on local passenger-car travel. The maximum gain in total travel, 3 percent, was found in the New England, South Atlantic, and West South Central regions. There was an increase in all other regions except the East South Central where there was no change, and the East North Central where there was a decrease of 1 percent.

The percentage of travel by vehicle types on main rural roads in the summer of 1954 is given in table 6 for the nine census regions and the three main geographic regions. The table shows that the largest percentage of passenger-car travel is in New England with the percentages in the Pacific and East North Central regions following closely. A comparison of truck travel shows that the East South Central region has the largest percentage of travel by all types of trucks and combinations, with the West South Central and Mountain regions following in order. The lowest percentage is in New England. Travel by all types of combinations in the East North Central region exceeds all other regions and is followed in order by the Middle Atlantic and the West North Central. When the comparison is restricted to travel by truck and full-trailer combinations, the Pacific and Mountain regions are the only ones with an appreciable proportion of vehicles of this type.

When the percentage distribution of travel by types of motor-vehicles given in table 6 is compared with a similar distribution previously published for 1950, it is found that during the 1950–54 period, the percentage of passenger-car travel increased from 76.15 to 78.28 percent; that of single-unit trucks decreased from 15.63 to 14.31 percent; and combinations decreased from 7.21 to 6.68 percent. These figures show, as was noted in the discussion concerning table 5, that travel by trucks and combinations has not expanded as fast as passenger-car travel since 1950.

Weight Stations Operated

During the summer of 1954, a total of 516 loadometer or pitscale stations were operated in 42 States for the purpose of collecting trend data concerning vehicle types, weights, and loading practices. During this survey, 395,050 trucks and truck combinations passing the stations were counted and classified according

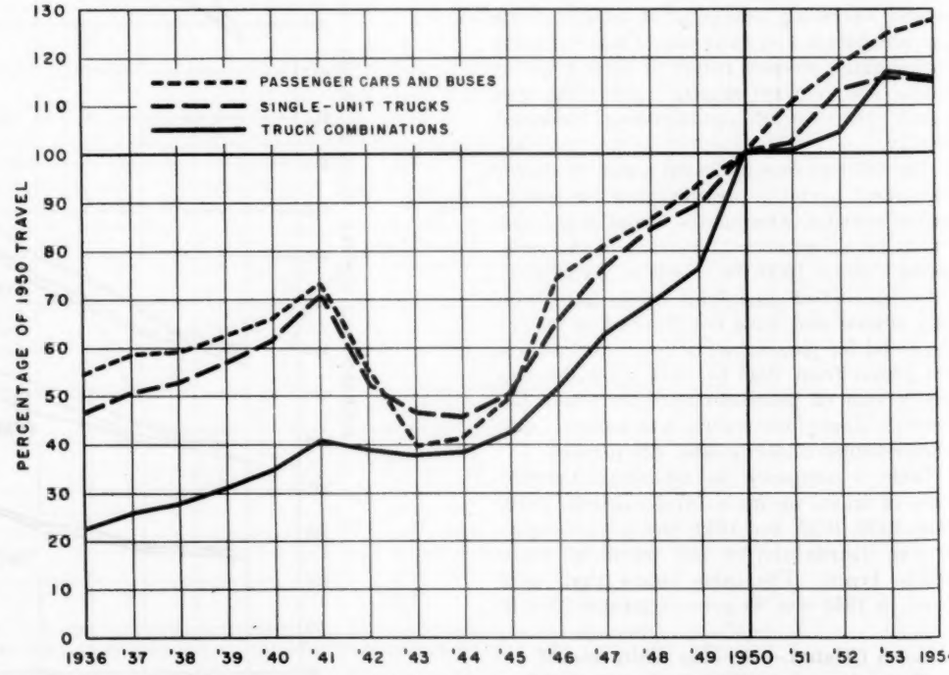

Figure 7.—Travel by passenger vehicles, single-unit trucks, and truck combinations on main rural roads, 1936–54, as a percentage of such travel in 1950.

Table 4.—Comparison of estimated vehicle-miles of travel on main rural roads in 1940, 1945, 1950, 1953, and 1954

Year	All vehicles, vehicle-miles	Passenger cars and buses		All trucks and truck combinations		Single-unit trucks		Truck combinations	
		Percentage of all vehicles	Vehicle-miles	Percentage of all vehicles	Vehicle-miles	Percentage of all trucks and truck combinations	Vehicle-miles	Percentage of all trucks and truck combinations	Vehicle-miles
	Millions		*Millions*		*Millions*		*Millions*		*Millions*
1940	109,815	80.8	88,715	19.2	21,100	79.1	16,699	20.9	4,401
1945	85,792	78.0	66,885	22.0	18,907	71.9	13,602	28.1	5,305
1945: 1940 ratio	*.78*	*.97*	*.75*	*1.15*	*.90*	*.91*	*.81*	*1.34*	*1.21*
1950	174,349	77.2	134,527	22.8	39,822	68.4	27,257	31.6	12,565
1950: 1945 ratio	*2.03*	*.99*	*2.01*	*1.04*	*2.11*	*.95*	*2.00*	*1.12*	*2.37*
1950: 1940 ratio	*1.59*	*.96*	*1.52*	*1.19*	*1.90*	*.86*	*1.63*	*1.51*	*2.86*
1953	213,604	78.4	167,445	21.6	46,159	68.1	31,435	31.9	14,724
1953: 1950 ratio	*1.23*	*1.02*	*1.24*	*.95*	*1.16*	*.99*	*1.15*	*1.01*	*1.17*
1953: 1945 ratio	*2.49*	*1.01*	*2.50*	*.98*	*2.44*	*.95*	*2.31*	*1.14*	*2.78*
1953: 1940 ratio	*1.95*	*.97*	*1.89*	*1.15*	*2.19*	*.86*	*1.88*	*1.53*	*3.35*
1954	217,059	79.0	171,506	21.0	45,553	68.2	31,064	31.8	14,489
1954: 1953 ratio	*1.02*	*1.01*	*1.02*	*.97*	*.98*	*1.01*	*.99*	*.99*	*.98*
1954: 1950 ratio	*1.24*	*1.02*	*1.27*	*.92*	*1.14*	*.99*	*1.14*	*1.01*	*1.15*
1954: 1945 ratio	*2.53*	*1.01*	*2.56*	*.95*	*2.41*	*.95*	*2.28*	*1.13*	*2.73*
1954: 1940 ratio	*1.98*	*.98*	*1.93*	*1.09*	*2.16*	*.86*	*1.86*	*1.52*	*3.29*

to the number of axles and tire equipment. Of that number, 134,488 vehicles were weighed and a record was made of the type of each vehicle, the weight of each of its axles, the spacing in feet between each pair of axles, and whether the vehicle was loaded or empty.

The stations used in the 1954 survey were located at the same points as in former years, most of them being at sites operated in the original surveys in the 1936–40 period. From comparable data collected at these locations trends in travel, loading practices, and carried loads were obtained, which, when applied to former estimates derived from comprehensive surveys, gave current estimates of vehicle-miles traveled by loaded vehicles and the carried load. The product of these two factors is the ton-miles of carried load. Data concerning the frequency of overloading and of heavy axle and heavy gross weight occurrence also are made available. The remaining

Table 5.—Ratio of 1954 traffic on main rural roads to corresponding traffic in 1953, by regions

Vehicle type	Eastern regions [1]				Central regions [2]					Western regions [3]			United States average
	New England	Middle Atlantic	South Atlantic	Average	East North Central	East South Central	West North Central	West South Central	Average	Mountain	Pacific	Average	
Passenger cars:													
Local	1.04	1.04	1.07	1.06	1.01	1.00	1.06	1.02	1.02	1.04	1.04	1.04	1.04
Foreign	1.02	.96	1.01	1.00	.99	.97	.97	1.09	1.00	.96	.99	.97	.99
All passenger cars	1.03	1.03	1.05	1.04	1.00	.99	1.04	1.03	1.01	1.00	1.03	1.02	1.03
Trucks and truck combinations:													
Single-unit trucks	1.03	.99	.94	.97	.95	1.06	.92	1.01	.99	1.07	.99	1.03	.99
Truck combinations	.96	1.02	.94	.97	.92	.91	1.04	1.14	.99	1.04	.98	1.10	.98
All trucks and combinations	1.01	1.00	.94	.97	.93	1.03	.96	1.04	.99	1.06	.99	1.02	.99
Buses	1.04	.95	.94	.96	.86	.90	.81	.83	.85	1.02	.91	.95	.91
All vehicles	1.03	1.02	1.03	1.03	.99	1.00	1.02	1.03	1.00	1.02	1.02	1.02	1.02

[1] Includes toll road vehicle-mileage for Maine, New Hampshire, New Jersey, and Pennsylvania.
[2] Includes toll road vehicle-mileage for Oklahoma (Turner Turnpike).
[3] Includes toll road vehicle-mileage for Colorado (Denver-Boulder Turnpike).

Table 6.—Percentage distribution of travel by vehicle types on main rural roads in the summer of 1954, by regions

Vehicle type	Eastern regions				Central regions					Western regions			United States average
	New England	Middle Atlantic	South Atlantic	Average	East North Central	East South Central	West North Central	West South Central	Average	Mountain	Pacific	Average	
Passenger cars:													
Local	62.22	64.89	58.64	61.32	61.85	49.73	62.91	59.84	59.62	39.45	69.48	58.19	59.03
Foreign	21.58	14.40	20.28	18.45	18.80	21.65	17.01	13.64	17.55	35.81	11.27	20.50	18.35
All passenger cars	83.80	79.29	78.92	79.77	80.65	71.38	79.92	73.48	77.17	75.26	80.75	78.69	78.28
Single-unit trucks:													
Panel and pickup	3.70	3.66	7.15	5.44	5.21	11.42	5.84	11.46	7.94	10.99	7.03	8.52	7.22
Other 2-axle, 4-tire	1.47	1.43	.48	.95	.23	.12	.46	.25	.27	1.02	1.10	1.07	.63
Other 2-axle, 6-tire	5.58	6.80	5.72	6.07	4.76	9.65	5.89	7.04	6.37	5.48	3.78	4.42	5.93
3-axle	.50	.47	.77	.63	.40	.67	.43	.17	.39	.68	.73	.71	.53
All single-unit trucks	11.25	12.36	14.12	13.09	10.60	21.86	12.62	18.92	14.97	18.17	12.64	14.72	14.31
Truck-tractor and semitrailer combinations:													
3-axle	3.18	5.20	2.43	3.50	3.16	3.41	2.22	2.95	2.94	1.22	.67	.88	2.77
4-axle	.83	2.34	3.53	2.72	4.08	2.25	3.59	3.61	3.56	1.09	.76	.88	2.82
5-axle or more	.01	.03	.02	.02	.51	.04	.84	.22	.43	2.43	2.71	2.60	.68
All truck-tractor and semitrailer combinations	4.02	7.57	5.98	6.24	7.75	5.70	6.65	6.78	6.93	4.74	4.14	4.36	6.27
Truck and trailer combinations:													
4-axle or less	.01	.04	.04	.03	.07	.01	.25	.13	.12	.30	.21	.24	.11
5-axle	------	.03	------	.01	.32	------	.03	.01	.13	.72	.86	.81	.21
6-axle or more	------	------	------	------	.10	------	(1)	------	.03	.15	.62	.45	.09
All truck and trailer combinations	.01	.07	.04	.04	.49	.01	.28	.14	.28	1.17	1.69	1.50	.41
All combinations	4.03	7.64	6.02	6.28	8.24	5.71	6.93	6.92	7.21	5.91	5.83	5.86	6.68
All trucks and truck combinations	15.28	20.00	20.14	19.37	18.84	27.57	19.55	25.84	22.18	24.08	18.47	20.58	20.99
Buses	.92	.71	.94	.86	.51	1.05	.53	.68	.65	.66	.78	.73	.73
All vehicles	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

[1] Less than 0.005 percent.

Table 7.—Average weight (in pounds) of loaded and empty trucks and truck combinations, by vehicle types, in the summer of 1954, by regions

Vehicle type	Eastern regions				Central regions					Western regions			United States average
	New England	Middle Atlantic	South Atlantic	Average	East North Central	East South Central	West North Central	West South Central	Average	Mountain	Pacific	Average	
AVERAGE WEIGHTS OF LOADED VEHICLES													
Single-unit trucks:													
Panel and pickup	5,415	4,918	5,430	5,302	5,177	5,509	5,339	5,566	5,405	5,316	4,924	5,083	5,307
Other 2-axle, 4-tire	6,121	6,100	7,109	6,370	6,567	6,763	7,464	6,754	6,993	7,076	6,371	6,622	6,582
Other 2-axle, 6-tire	15,797	14,831	14,497	14,806	13,204	15,277	14,332	13,565	14,016	14,721	14,273	14,461	14,337
3-axle	40,396	34,220	30,441	32,490	29,788	28,790	27,870	30,470	29,129	31,657	30,003	30,420	30,702
Average	12,884	12,523	12,184	12,401	10,594	11,431	10,874	9,607	10,583	10,091	10,228	10,173	11,021
Truck combinations:													
Truck-tractor and semitrailer	40,593	38,010	41,415	39,934	41,245	38,262	42,726	40,090	40,926	50,845	54,445	53,077	42,327
Truck and trailer	------	49,620	54,200	52,414	68,524	46,228	34,141	39,968	53,451	64,336	62,226	62,764	59,422
Average	40,593	38,057	41,488	39,991	42,382	38,266	42,324	40,087	41,350	52,872	56,315	55,096	43,259
Average, all trucks and combinations	21,348	24,046	23,700	23,531	26,251	18,270	23,572	20,680	22,796	24,344	27,600	26,354	23,661
AVERAGE WEIGHTS OF EMPTY VEHICLES													
Single-unit trucks:													
Panel and pickup	4,495	3,784	4,032	4,013	3,958	4,159	4,350	4,148	4,133	4,029	4,156	4,085	4,091
Other 2-axle, 4-tire	4,569	4,454	5,597	4,760	4,796	6,093	6,165	5,435	5,507	5,269	4,821	4,983	4,976
Other 2-axle, 6-tire	10,112	8,682	8,094	8,591	7,949	8,271	8,206	8,147	8,149	8,656	8,410	8,546	8,340
3-axle	22,231	15,420	13,535	15,138	14,416	12,465	14,302	14,173	13,758	17,161	16,089	16,691	14,912
Average	7,658	6,576	5,680	6,182	5,652	6,006	6,280	5,470	5,768	5,624	5,530	5,580	5,865
Truck combinations:													
Truck-tractor and semitrailer	23,172	20,258	21,052	20,917	21,353	19,691	21,629	20,259	20,846	26,721	27,064	26,883	21,325
Truck and trailer	19,650	23,642	27,450	24,782	27,544	23,416	17,092	21,284	25,892	28,390	29,685	29,221	27,856
Average	23,170	20,316	21,096	20,958	21,955	19,694	21,507	20,275	21,087	27,241	28,306	27,817	21,825
Average, all trucks and combinations	10,889	10,656	8,785	9,650	11,365	8,084	10,478	8,212	9,391	8,895	10,025	9,431	9,478

tables and charts in this article have been calculated by means of these trends, or by combining the actual data gathered in the summer survey with data developed from trends.

The average weights of loaded and empty trucks and truck combinations according to vehicle types are given in table 7 for each of the census regions, the main geographic regions, and for the United States as a whole in the summer of 1954. From this table it will be seen that the heaviest average weight of loaded single-unit trucks was found in New England with the Middle Atlantic region being slightly less. The heaviest average weight of truck combinations was found in the Pacific region with that in the Mountain region being slightly smaller. The highest average weight for loaded trucks and combinations of all types was in the Pacific region and the lowest in the East South Central region. The average empty weights followed a regional pattern similar to that for the average loaded weights.

Pay Load Determined

If it is assumed that the average empty weight of loaded vehicles of a given type is the same as the average weight of empty vehicles of that same type, then subtracting average empty weight from average loaded weight gives average carried load for the vehicle type. On this basis, the average loads carried in vehicles of different types and the relation of these loads to the average loaded weights of the vehicles are as shown in table 8. Thus, in general, the heavier the vehicle type the larger the proportion of the gross weight on the average that consists of carried load or pay load. The pay load for three or more axle trucks and combinations averages about one-half of the total weight of the loaded vehicle, whereas for two-axle vehicles it averages much less.

The vehicle weights of loaded and empty single-unit trucks and truck combinations on main rural roads from 1936 to 1954 are given in figure 8 as a percentage of such weights in 1950. The weights of single-unit trucks, loaded or empty, have changed little in the period of years included, being only about 10 percent greater in 1954 than in 1936. Truck-combination weights, on the other hand, have increased rather steadily throughout the period—the loaded weights being about 61 percent greater and the empty weights about 73 percent greater in 1954 than in 1936.

Travel by Loaded and Empty Trucks

The volume of travel on main rural roads by loaded and empty trucks and truck combinations is shown in figure 9 for each year from 1936 to 1954, inclusive. Probably the most interesting feature of the graph is the change in the relation between loaded and empty single-unit trucks which took place during the war years and has continued since. In 1936 almost 61 percent of the single-unit trucks were loaded. With the large expansion of hauling that occurred in 1941 as the Nation prepared for war, that figure increased to 65 percent loaded. When war developed and driving restrictions were invoked, many small truck owners found it advantageous to drive these vehicles instead of their automobiles for general transportation purposes. Thus it soon developed that the lighter-weight trucks were being used more frequently for personal transportation than had previously been the case.

This revolutionary change in the use of the smaller vehicles was carried to such an extent that in 1945 it was found that even including the heavier trucks in the general single-unit classification, these vehicles were being used for the transportation of goods on less than one-half of their travel. After the war was over, the popularity of the light-weight trucks as a means of personal transportation appears to have continued, and in 1949 only about 46 percent of their travel involved carrying a load. The corresponding figure for 1954 is 49 percent. At no time since the war has travel by loaded

Table 8.—Average carried loads by trucks and truck combinations in the summer of 1954, in relation to the average loaded weights of such vehicles

Vehicle type	Average loaded weight	Average empty weight	Average carried load	Relation of carried load to loaded weight
	Lbs.	*Lbs.*	*Lbs.*	*Pct.*
Single-unit trucks:				
Panel and pickup	5,307	4,091	1,216	22.9
Other 2-axle, 4-tire	6,582	4,976	1,606	24.4
Other 2-axle, 6-tire	14,337	8,340	5,997	41.8
3-axle	30,702	14,912	15,790	51.4
Truck combinations:				
Truck-tractor and semitrailer	42,327	21,325	21,002	49.6
Truck and trailer	59,422	27,856	31,566	53.1

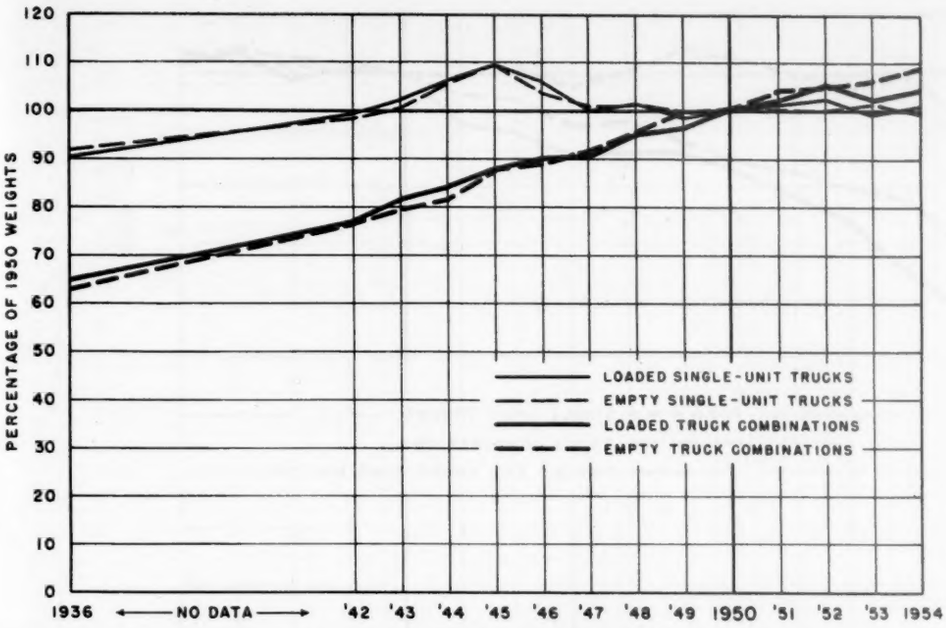

Figure 8.—Average weights of loaded and empty trucks and truck combinations on main rural roads, 1942–54 and a prewar year, as a percentage of such weights in 1950.

single-unit trucks equalled that by empty vehicles of this type.

For truck combinations, the relation between the loaded and empty vehicle-mileage of travel has been fairly uniform throughout the entire period. In 1936, 72 percent of the travel was made by loaded vehicles while in 1954 the figure was 68 percent. The vehicle-mileage of loaded single-unit trucks in 1954 was about double that in 1936, while the vehicle-mileage of loaded combinations was nearly five times that in the earlier years.

Volume of Freight Hauled

The average load carried by trucks and truck combinations on main rural roads from 1936 to 1954 is shown in figure 10 as a percentage of the amounts carried in 1950. For single-unit trucks, the average load increased about 23 percent from 1936 to 1941. Since that time loads have remained relatively constant, the curve fluctuating slightly above and below the 100-percent line on the chart. On the other hand, the average load for truck combinations increased rather steadily from 1936 to 1950 and has changed but little since then—the 1954 figure being but 2.7 percent above that for 1950. For the period 1936–54, the increase in average carried load was 29 percent for single-unit trucks and 58 percent for truck combinations. Due to the increasing use of truck combinations, the average weight of loads carried by all trucks and truck combinations had a still greater increase, amounting to 98 percent.

The ton-mileage of loads carried by trucks and truck combinations on main rural roads from 1936 to 1954 is shown in figure 11 as a percentage of amounts in 1950. From 1936 to 1950, the ton-mileage of loads carried increased 108 percent for single-unit trucks and 565 percent for truck combinations. For all trucks and combinations, the increase was 332 percent. From 1950 to 1954, the increase in ton-mileage was more gradual, and was slightly less for truck combinations than for single-unit trucks. The increases over this 4-year period were 23 percent for single-unit trucks, 17 percent for truck combinations, and 19 percent for all vehicles. For the period 1936–54, the increase was 156 percent for single-unit trucks, 681 percent for truck combinations, and 414 percent for all vehicles.

The actual ton-mileage of freight carried annually from 1936 to 1954, inclusive, by trucks and truck combinations on main rural roads is shown in figure 12. The chart shows the tremendous growth in ton-miles of freight transported by truck combinations since the beginning of the planning surveys. In 1936 an estimated 13.7 billion ton-miles were transported by these combination-type vehicles, and slightly less than 14.3 billion ton-miles were transported by single-unit trucks. By 1940, the combination vehicles were hauling more than the single-unit trucks and by 1953, the ton-mileage hauled by combinations was more than three times that by single-unit trucks. With the general slackening in business in 1954, hauling by combinations dropped slightly while that by single-unit trucks continued to rise, with the result that the ton-mileage hauled by combinations was somewhat less than three times the ton-mileage by single-unit trucks.

The growth in ton-mileage by single-unit trucks and truck combinations from 1936 to 1954 is illustrated in another manner in figure 13 (p. 242). Ton-mileage is the product of vehicle-mileage traveled by loaded vehicles and the average tonnage carried by each vehicle; this chart shows the changes that have taken place in each of these factors. The horizontal scale measures the vehicle-mileage for loaded

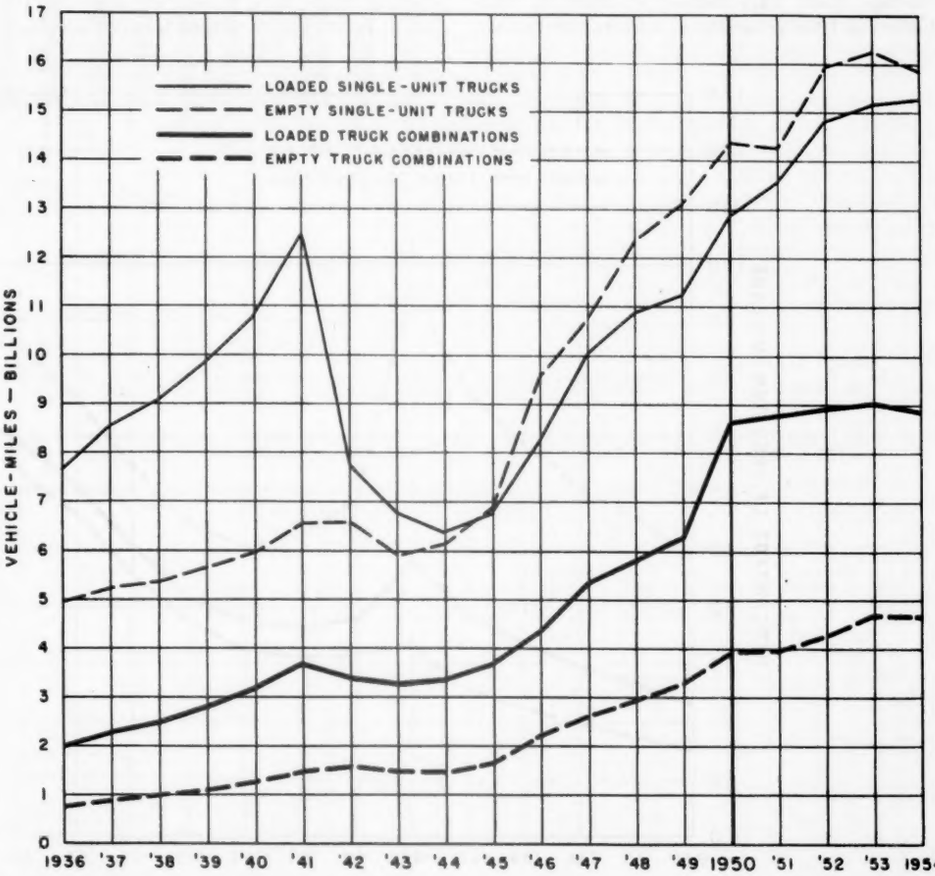

Figure 9.—Vehicle-miles of travel on main rural roads by loaded and empty trucks and truck combinations, 1936–54.

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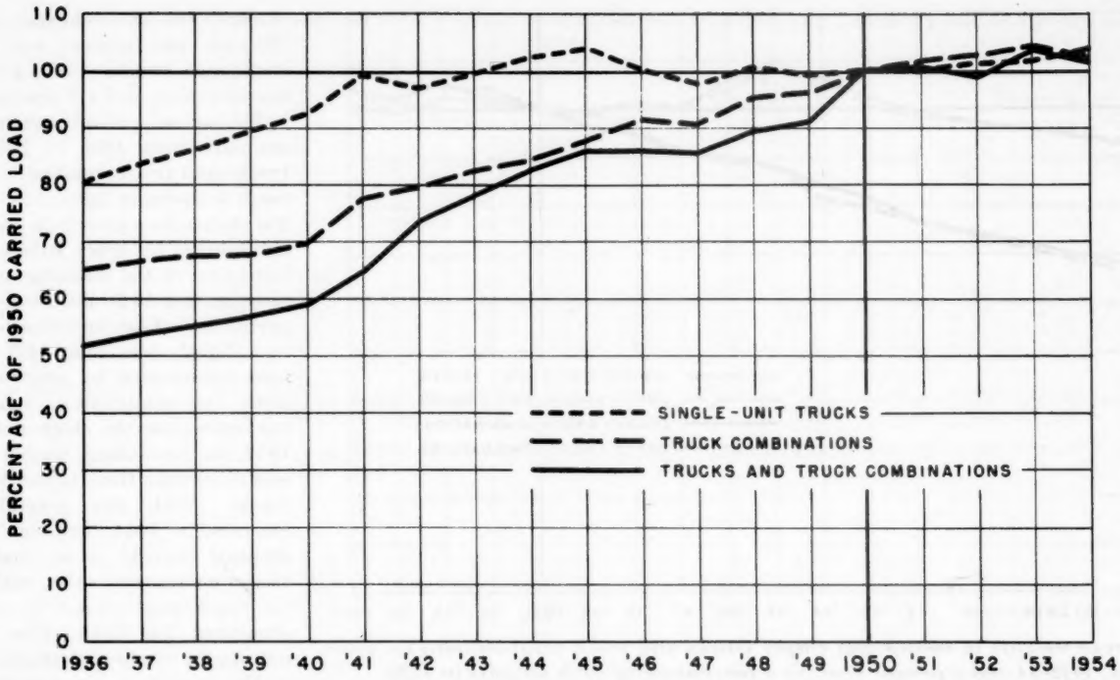

Figure 10.—Average loads carried by trucks and truck combinations on main rural roads, 1936–54, as a percentage of the amounts carried in 1950.

vehicles of each type, and the vertical scale measures the average carried load. Ton-mileage, the product of these two factors, is represented by the areas of the rectangles.

For single-unit trucks, the increase in ton-mileage from 14.3 billion in 1936 to 36.6 billion in 1954 came about mainly through an increase in the vehicle-mileage of loaded vehicles, since there was very little increase in the average carried load for this class of vehicles, especially from 1950 to 1954. For truck combinations, the increase in ton-mileage from 13.7 billion in 1936 to 107.3 billion in 1954 came about through a substantial increase in average carried load, and a much greater proportional increase in the vehicle-mileage of loaded vehicles.

It can be seen from figure 13 that almost the entire development of the movement of freight over the highways by the heavy combination-type vehicle has taken place

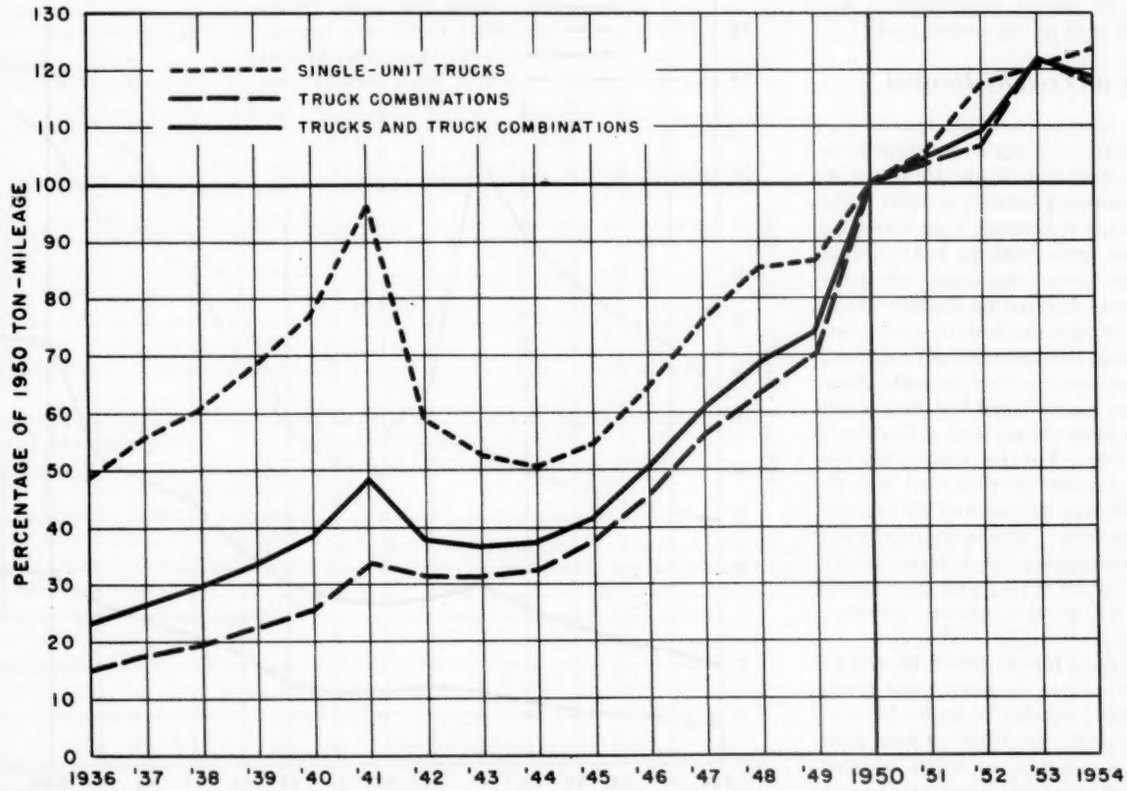

Figure 11.—Ton-miles carried by trucks and truck combinations on main rural roads, 1936–54, as a percentage of the amounts carried in 1950.

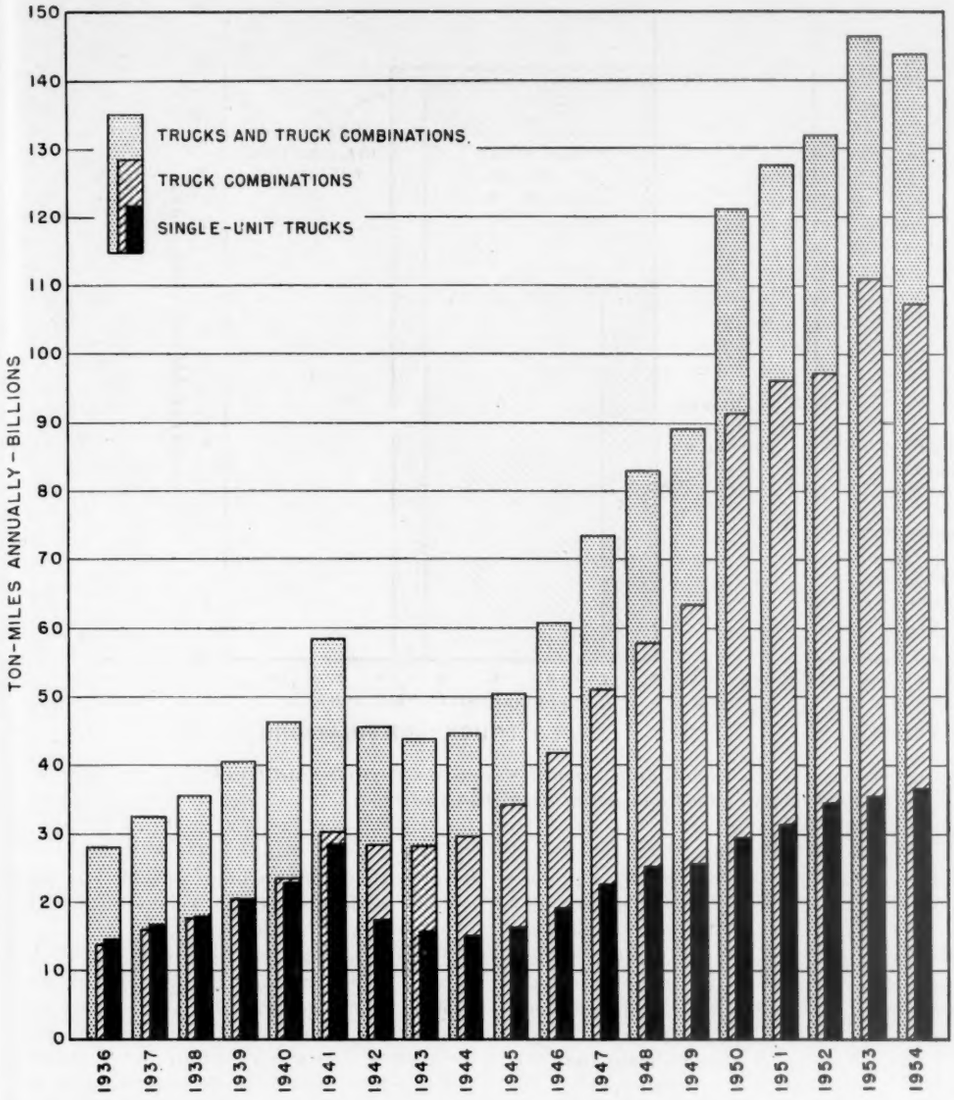

Figure 12.—Ton-miles carried by trucks and truck combinations on main rural roads, 1936–54.

since 1936. In that year, over one-half of the hauling, measured in ton-mileage, was performed by single-unit trucks; in 1954 about three-fourths of it was done by the heavy combination vehicles.

A comparison of the estimated percentage of trucks loaded, average carried load, and ton-miles of freight carried on main rural roads in 1940, 1945, 1950, 1953, and 1954 is given separately for single-unit trucks and truck combinations in table 9. The table shows the extent to which the ton-mileage gains were due to increased loading per vehicle. The increases beyond this point resulted, of course, from increased mileage by loaded vehicles.

In considering the 1954:1940 ratios on the bottom line of the table for example, it will be noted that the ton-mileage hauled by combinations was 4.6 times as great at the end of this 14-year period as it was at the beginning, while the ratio for the average weight of carried load was 1.47 and the ratio for the percentage of vehicles loaded was 0.95. From table 4, the corresponding ratio for the vehicle-mileage traveled by all vehicles of this type both loaded and empty was 3.29, which when multiplied by 0.95 gives a ratio of 3.13 for loaded vehicles. Obviously, most of the enormous increase in ton-mileage was due to increased vehicle-mileage rather than to heavier loading, though the latter factor was of considerable importance in the case of the combination-type vehicle.

For single-unit trucks, the percentage of vehicles loaded decreased more than the average load increased during the period 1940–54. In other words, there was an actual decrease in the average load for vehicles of this type when both loaded and empty vehicles were included in computing the average. The 60-percent increase in ton-mileage carried by single-unit trucks was therefore smaller than the increase in vehicle-mileage, which was 86 percent as shown by the ratio in table 4.

Comparative information in greater detail than table 9 concerning the percentage of vehicle-miles of travel, percentage loaded, the average carried load, and percentage of total ton-miles hauled on main rural roads in 1954 and 1953 is given in table 10. Many interesting comparisons may be made from these data. For instance, two-axle, six-tire, single-unit trucks, which are the principal load-carrying single-unit vehicles and account for about 28 percent of the total truck travel, carry only about 18 percent of the ton-mileage. On the other hand, truck-tractor and semi-trailer combinations account for slightly less than 30 percent of the total vehicle-mileage (about the same as the two-axle, six-tire trucks), but carry about 68 percent of the ton-mileage or almost four times the amount carried by the smaller vehicles.

The data concerning percentage loaded and average carried load are also interesting. Panels and pickups, which carry loads of three-fourths of a ton or less, travel loaded less than 40 percent of the time. Assuming that there is a return trip with no load for each trip with a load, only 80 percent of the travel can be accounted for on the basis of the hauling of goods. Since vehicles are often loaded in both directions, the use of these vehicles as a substitute for passenger cars must be well in excess of 20 percent of their total travel.

The slightly larger two-axle trucks, with single tires and carrying loads averaging

Table 9.—Comparison of estimated percentage of trucks loaded, average carried load, and ton-miles carried on main rural roads in 1940, 1945, 1950, 1953, and 1954

Year	All trucks and truck combinations			Single-unit trucks			Truck combinations		
	Percentage loaded	Average weight of carried load	Ton-miles carried	Percentage loaded	Average weight of carried load	Ton-miles carried	Percentage loaded	Average weight of carried load	Ton-miles carried
		Tons	*Millions*		*Tons*	*Millions*		*Tons*	*Millions*
1940	65.9	3.32	46,247	64.4	2.13	22,899	71.6	7.41	23,348
1945	55.1	4.84	50,365	49.6	2.40	16,187	69.2	9.31	34,178
1945: 1940 ratio	*.83*	*1.46*	*1.09*	*.77*	*1.13*	*.71*	*.97*	*1.26*	*1.46*
1950	53.9	5.64	121,091	47.2	2.31	29,645	68.5	10.62	91,446
1950: 1945 ratio	*.98*	*1.17*	*2.40*	*.95*	*.96*	*1.83*	*.99*	*1.14*	*2.68*
1950: 1940 ratio	*.82*	*1.70*	*2.62*	*.73*	*1.08*	*1.29*	*.96*	*1.43*	*3.92*
1953	54.6	5.82	146,810	48.2	2.35	35,602	68.2	11.07	111,208
1953: 1950 ratio	*1.01*	*1.03*	*1.21*	*1.02*	*1.02*	*1.20*	*.99*	*1.04*	*1.22*
1953: 1945 ratio	*.99*	*1.20*	*2.91*	*.97*	*.98*	*2.20*	*.98*	*1.19*	*3.25*
1953: 1940 ratio	*.83*	*1.75*	*3.17*	*.75*	*1.10*	*1.55*	*.95*	*1.49*	*4.76*
1954	55.1	5.74	143,901	49.1	2.40	36,559	67.9	10.91	107,342
1954: 1953 ratio	*1.01*	*.99*	*.98*	*1.02*	*1.02*	*1.03*	*1.00*	*.99*	*.97*
1954: 1950 ratio	*1.02*	*1.02*	*1.19*	*1.04*	*1.04*	*1.23*	*.99*	*1.03*	*1.17*
1954: 1945 ratio	*1.00*	*1.19*	*2.86*	*.99*	*1.00*	*2.26*	*.98*	*1.17*	*3.14*
1954: 1940 ratio	*.84*	*1.73*	*3.11*	*.76*	*1.13*	*1.60*	*.95*	*1.47*	*4.60*

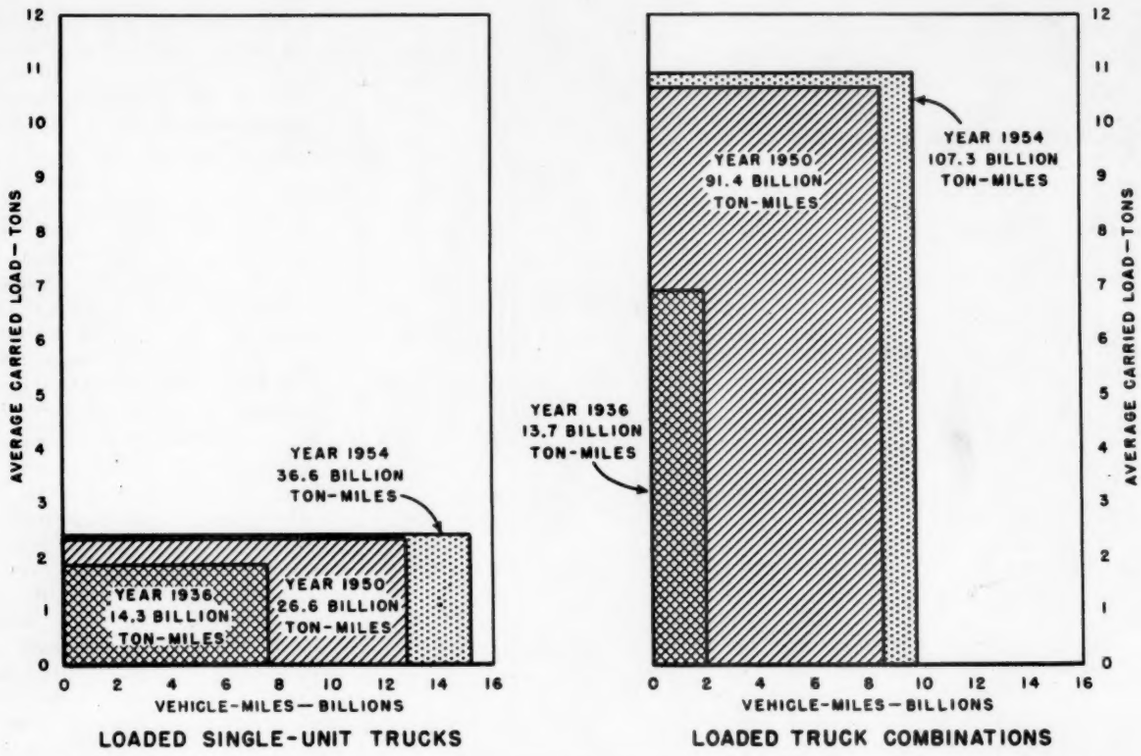

Figure 13.—Vehicle-miles of travel, average carried load, and ton-miles carried by trucks and truck combinations on main rural roads in 1954 compared with 1936 and 1950.

around one ton, are loaded about one-half of the time indicating still some use for personal transportation, while the larger single-unit vehicles operate with a load almost 60 percent of the time. Many of the truck combinations are common carriers which seldom are operated empty, inasmuch as they continually are picking up and discharging freight. They are found loaded, therefore, in larger proportion than the large single-unit trucks. Many of the latter type carry loads of a one-way variety, such as hauling building materials to a construction project.

Shift to Two-Axle Semitrailers

The percentage of vehicle-mileage traveled by trucks of various types in 1954 compared with 1950 is shown in figure 14. An interesting fact shown by this chart is the great shift that took place in this short period of time from single-axle semitrailers to those equipped with dual axles. In the earlier period, 18.5 percent of the truck and truck combination travel was made by two-axle tractors pulling single-axle semitrailers, while travel by the same type of tractor with dual-axle semitrailers amounted to only 9.0 percent.

The 1954 survey figures indicate that this relation has changed materially, and the percentage for the dual-axle semitrailers now exceeds the percentage for the single-axle semitrailers. Considerable expansion in the use of three-axle tractors pulling semitrailers equipped with dual axles likewise may be noted, though the percentage for this vehicle type is still relatively low for the country as a whole. These vehicles still are found principally in the western regions, although more are being used elsewhere especially in the north central regions. The shift from one-axle to two-axle semitrailers has taken place in order that the maximum possible pay load can be carried under the weight restrictions in effect in some States.

The percentage of ton-miles hauled by various truck types in 1954 compared with 1950 is shown in figure 15. This chart emphasizes, even more than figure 14, the shift from three-axle tractor-semitrailer combinations to four- and five-axle combinations between 1950 and 1954. In 1954, the four-axle combinations accounted for a larger portion of the ton-mileage than any other single vehicle type, whereas in 1950 the three-axle combinations predominated.

Heavy Gross-Load Frequencies

The frequency of gross loads of 30,000 40,000, and 50,000 pounds or more per 1,000 trucks and truck combinations on main rural roads in the summer of 1954 is shown for the different census regions in figure 16. This chart shows that the greatest frequency of such heavy vehicles is found in the Pacific region. In that area in 1954, out of each 1,000 trucks and combinations including empties, 238 weighed 30,000 pounds or more, 177 weighed 40,000 pounds or more, while 149 weighed 50,000 pounds or more. The East North Central region ranked second for vehicles weighing over 30,000 pounds. Here it was found that for each 1,000 trucks and combinations, 230 weighed that amount or more, while 145 weighed 40,000 pounds or more, and 75 weighed 50,000 pounds or more. The West North Central region ranked third for vehicles weighing 30,000 pounds or more but ranked second for vehicles weighing 40,000 pounds and 50,000 pounds or more.

Table 10.—Percentage of vehicle-miles of travel, percentage loaded, average carried load, and percentage of total ton-miles carried on main rural roads in 1954 compared with 1953

Vehicle type	Percentage of vehicle-miles of travel		Percentage loaded		Average carried load		Percentage of ton-miles carried	
	1954	1953	1954	1953	1954	1953	1954	1953
Single-unit trucks:					*Tons*	*Tons*		
Panel and pickup	34.41	33.49	39.8	39.7	0.71	0.70	3.08	2.89
Other 2-axle, 4-tire	3.00	2.96	48.7	52.3	.89	1.03	.41	.50
Other 2-axle, 6-tire	28.28	29.02	59.7	58.3	3.36	3.25	17.93	17.18
3-axle	2.50	2.37	58.2	58.0	8.63	8.54	3.99	3.66
All single-unit trucks	68.19	67.84	49.1	49.0	2.40	2.34	25.41	24.23
Truck combinations:								
Truck-tractor and semitrailer	29.85	29.85	68.4	68.6	10.63	10.67	68.67	68.00
Truck and trailer	1.96	2.31	60.1	65.7	15.90	16.43	5.92	7.77
All truck combinations	31.81	32.16	67.9	68.4	10.91	11.07	74.59	75.77
All trucks and combinations	100.00	100.00	55.1	55.1	5.74	5.83	100.00	100.00

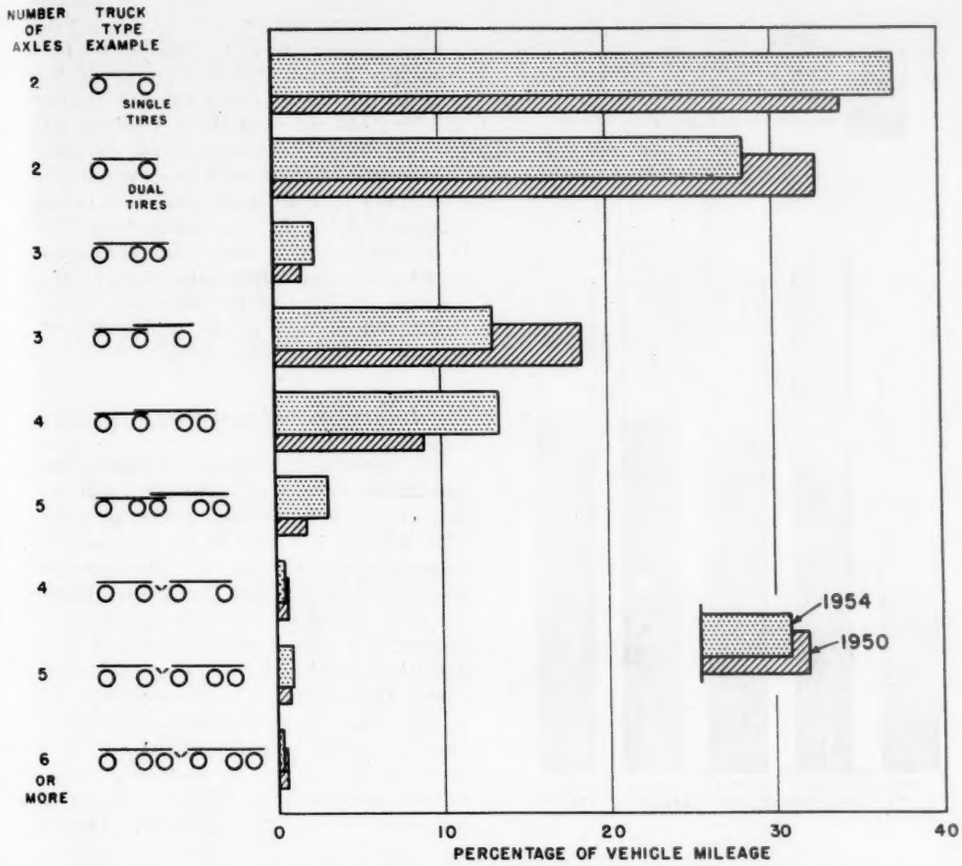

Figure 14.—Percentage of vehicle-mileage traveled by various types of trucks and truck combinations on main rural roads in 1954 compared with 1950.

weighing 30,000 pounds or more and of those weighing 40,000 pounds or more were slightly lower in 1954 than in 1953, the number of vehicles weighing 50,000 pounds or more reached an alltime high in 1954. Since the beginning of the planning surveys in the 1936–37 period, the frequency of loads of 30,000 pounds or more increased almost 350 percent, those of 40,000 pounds or more increased over 1,000 percent, and those of 50,000 pounds or more increased more than 2,000 percent.

The 1954 gross-weight frequency data by vehicle type and region are presented in table 11. Since no panels, pickups, or other two-axle, four-tire, single-unit trucks were found in the survey weighing as much as 30,000 pounds, there is no entry for these vehicles in the table. They are included, however, in the total number of vehicles weighed in computing the frequencies for all single-unit trucks and for all trucks and combinations.

As was noted in the discussion concerning figure 16, heavy gross weights are more frequent in the Pacific region than in other parts of the country. In this region, 238 of each 1,000 trucks and truck combinations weighed 30,000 pounds or more, while 731 of each 1,000 truck combinations weighed that much. Since about 21 percent of these vehicles in the Pacific region were empty, the number loaded per thousand was 790 and it is obvious that most of these weighed more than 30,000 pounds. In fact, a number of empty vehicles of this type weighed over 30,000 pounds and a few over 40,000 pounds.

Frequencies of 221, 148, and 93 were found in that area for the 30,000-, 40,000-, and 50,000-pound weight classes, respectively. The lowest frequencies of these heavy loads were found in the East South Central region where 145, 61, and 18, respectively, were found for the three groups.

Figure 17 shows the number of heavy gross weights per 1,000 loaded and empty trucks and truck combinations on main rural roads in the summers of 1942–54 and in a prewar year (1936–37 period). This chart shows the yearly variations in the frequencies of vehicles weighing 30,000, 40,000, or 50,000 pounds or more. During this period of about 18 years the trend of the frequency of vehicles weighing 50,000 pounds or more was rather consistently upward, and the frequency of those weighing 40,000 pounds or more was generally upward with temporary drops in 1947, 1952, and 1954. The long-range trend in frequency of weights of 30,000 pounds or more was also upward, but there was an important decline from 1945 to 1947. This decline proved to be quite temporary, however, and was followed by a rapid rise to 1950.

Since 1950 the frequency has fluctuated slightly up and down without changing significantly. While the frequencies of vehicles

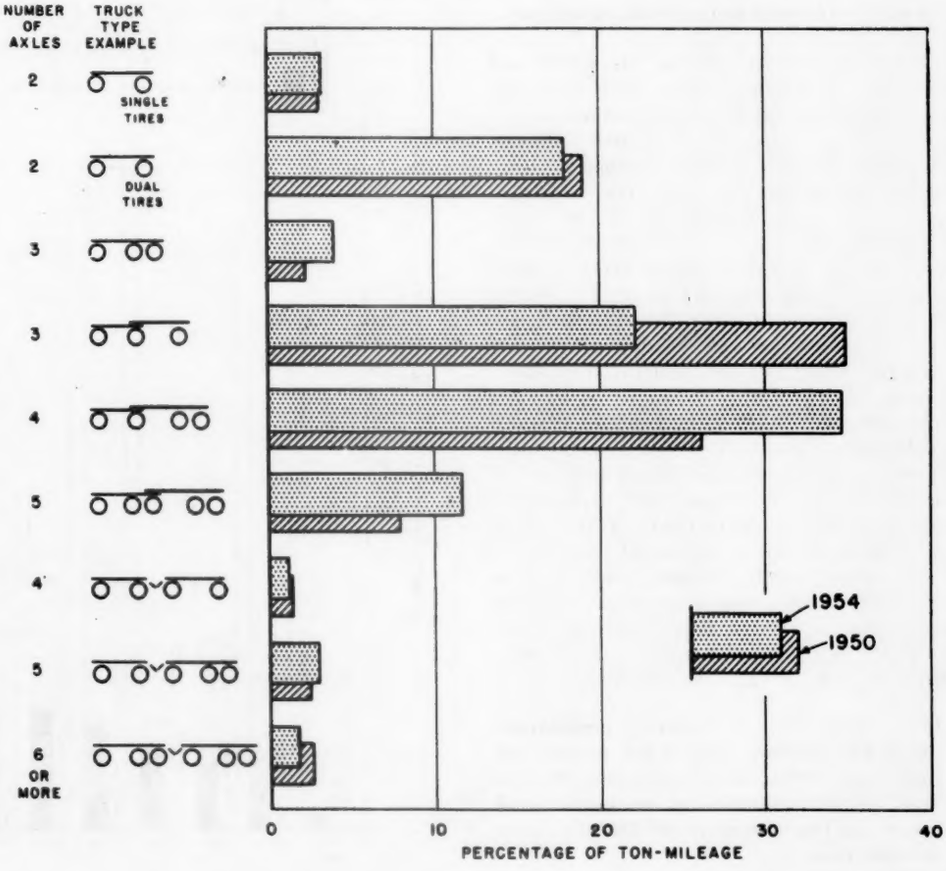

Figure 15 **(Right).**—*Percentage of ton-mileage hauled by various types of trucks and truck combinations on main rural roads in 1954 compared with 1950.*

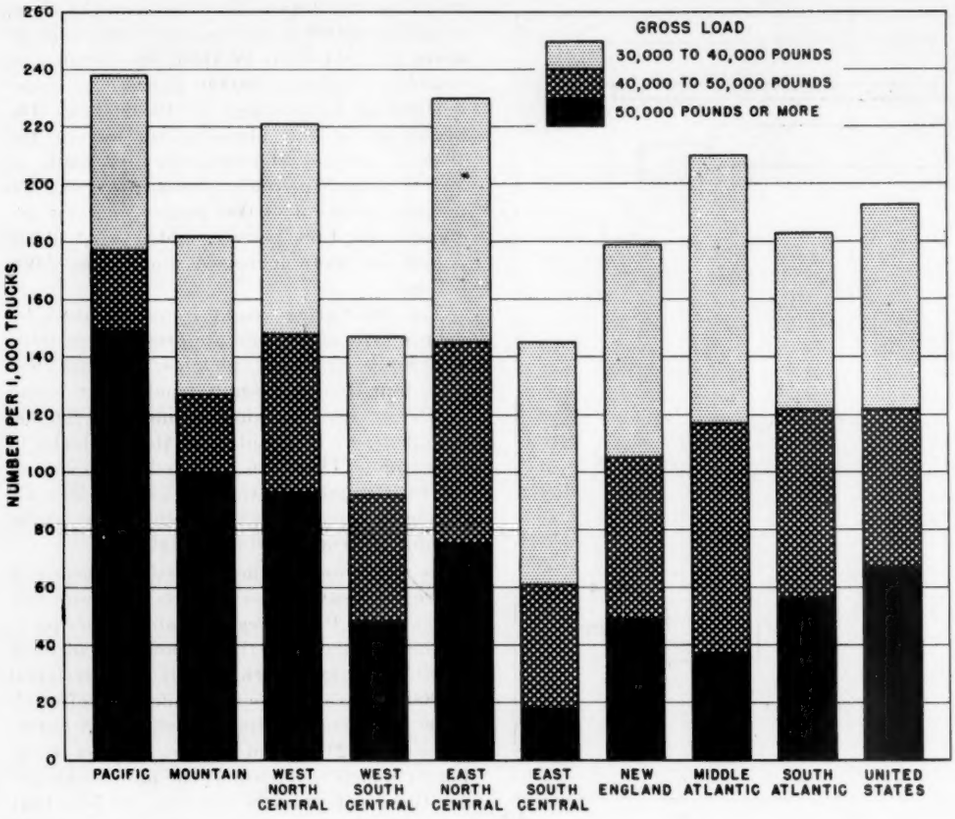

Figure 16* (Above).—*Number of gross loads of 30,000, 40,000, and 50,000 pounds or more, per 1,000 loaded and empty trucks and truck combinations, on main rural roads in the summer of 1954, by regions.

Other areas such as the Mountain and East South Central regions had extremely high frequencies of truck combinations weighing 30,000 pounds or more, which indicates that most of such vehicles weighed at least 30,000 pounds when loaded. The table also shows that almost one-half of the truck combinations found on the roads of the Pacific or Mountain regions weighed 50,000 pounds or more. High frequencies for heavy vehicles of the combination type are found in the western regions, while the heavier single-unit trucks are found most frequently in the eastern regions, especially New England.

Vehicle-miles of travel by trucks and truck combinations weighing 30,000, 40,000, and 50,000 pounds or more are shown in figure 18 for the summers of 1936 and 1942–54, as a percentage of such travel in 1950. This chart is based on the actual recurrence of these heavy loads in the traffic stream, and includes changes in traffic volume as well as in the frequencies of heavy loads per thousand vehicles. It shows that the vehicle-miles traveled by trucks and combinations, weighing 30,000 pounds or more, was over 1,000 percent greater in 1954 than in the prewar year, that the travel of those weighing 40,000 pounds or more was over 3,000 percent greater, and that the travel of those weighing 50,000 pounds or more was over 6,000 percent greater.

The rate of increase was especially great from 1949 to 1950, and since then has been materially less. As was seen in figure 17, the frequency of heavy gross loads per thousand vehicles has been fairly stable since 1950, and the upward slope of the curves in figure 18 from 1950 to 1953 is due principally to increased vehicle-mileage.

Heavy Axle-Load Frequencies

The number of axle loads of 18,000, 20,000, and 22,000 pounds or more per 1,000 trucks and truck-combinations in the summer of 1954 is given in figure 19 for the main rural roads of each census region. The most noticeable feature of the chart is the very high frequency of heavy axle loads in all three weight categories in the New England and Middle Atlantic regions and, to a lesser extent, in the South Atlantic region. The axle-load limits in most States in these areas are higher than those generally in effect elsewhere. In the New England region, for instance, Connecticut, Massachusetts, and Rhode Island permit axle loads up to 22,400 pounds; Maine and

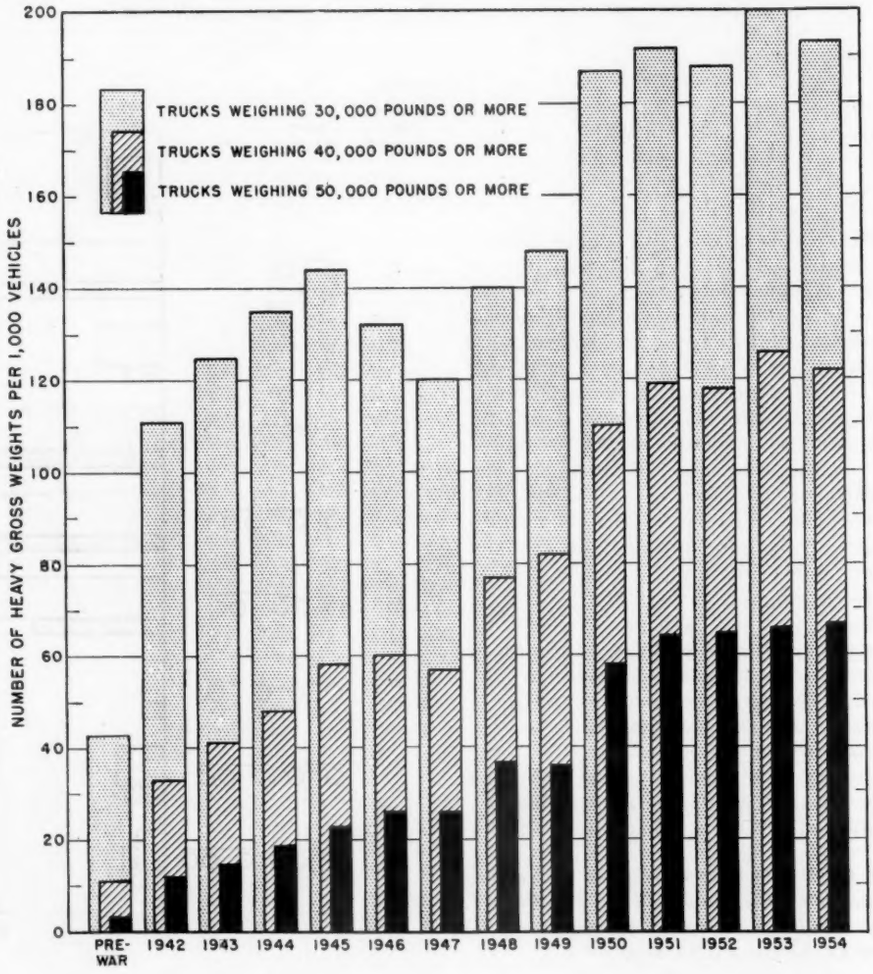

Figure 17* (Right).—*Number of gross loads of 30,000, 40,000, and 50,000 pounds or more, per 1,000 loaded and empty trucks and truck combinations, on main rural roads in the summers of 1942–54 and a prewar year.

Table 11.—Frequency of heavy vehicles of 30,000, 40,000, and 50,000 pounds or more, per 1,000 loaded and empty trucks and truck combinations, on main rural roads in the summer of 1954 by main vehicle types and by regions

Vehicle type	Eastern regions				Central regions					Western regions			United States average
	New England	Middle Atlantic	South Atlantic	Average	East North Central	East South Central	West North Central	West South Central	Average	Mountain	Pacific	Average	
Number per 1,000 Weighing 30,000 Pounds or More													
Single-unit trucks:													
2-axle, 6-tire	27	14	2	10	(1)	1	------	------	(1)	1	(1)	1	3
3-axle	507	365	251	311	313	252	324	405	309	340	200	251	296
Average	36	21	14	20	12	8	11	4	8	13	12	12	12
Truck combinations:													
Truck-tractor and semitrailer	578	516	583	545	510	671	611	544	561	694	729	715	577
Truck and trailer	------	(2)	------	(2)	522	------	409	209	455	734	735	735	623
Average	577	515	579	553	511	671	602	537	557	702	731	720	580
Average, all trucks and combinations	179	210	183	192	230	145	221	147	187	182	238	214	193
Comparative average, 1953	165	199	200	196	259	129	197	135	188	183	230	211	200
Comparative average, 1950	137	221	177	189	251	102	142	146	170	160	289	233	187
Number per 1,000 Weighing 40,000 Pounds or More													
Single-unit trucks:													
2-axle, 6-tire	6	(1)	(1)	1	------	1	------	------	(1)	(1)	------	(1)	(1)
3-axle	238	60	59	81	48	20	31	72	39	134	11	55	59
Average	14	3	3	4	2	1	1	1	1	5	1	3	2
Truck combinations:													
Truck-tractor and semitrailer	358	303	401	356	330	291	427	346	349	494	575	542	375
Truck and trailer	------	(2)	(2)	(2)	377	------	172	88	293	537	524	528	436
Average	358	303	399	355	333	291	416	340	348	502	561	539	378
Average, all trucks and combinations	105	117	122	118	145	61	148	92	114	127	177	155	122
Comparative average, 1953	98	112	125	117	179	56	131	84	120	128	182	159	126
Comparative average, 1950	78	135	95	109	140	45	82	70	95	106	214	167	110
Number per 1,000 Weighing 50,000 Pounds or More													
Single-unit trucks:													
2-axle, 6-tire	------	------	(1)	(1)	------	------	------	------	------	------	------	------	(1)
3-axle	92	29	1	19	3	------	4	------	2	8	6	7	10
Average	4	1	(1)	1	(1)	------	(1)	------	(1)	(1)	(1)	(1)	(1)
Truck combinations:													
Truck-tractor and semitrailer	176	95	187	148	160	87	267	183	178	384	472	436	199
Truck and trailer	------	(2)	------	(2)	354	------	129	70	266	494	469	476	393
Average	176	96	186	147	171	87	261	180	181	406	471	446	211
Average, all trucks and combinations	49	37	56	48	75	18	93	48	59	100	149	127	67
Comparative average, 1953	33	34	57	46	95	11	76	40	61	100	130	118	66
Comparative average, 1950	24	63	28	41	78	7	44	34	47	76	176	133	58

[1] Less than 5 per 10,000.
[2] Data omitted because of insufficient sample.

New Hampshire limit them to 22,000 pounds; while Vermont has no axle-load limit. A low gross-weight limitation in Vermont, however, restricts axle loading. In the Middle Atlantic region, New Jersey and New York permit axle weights up to 22,400 pounds, while Pennsylvania limits them to 20,000 pounds. Axle loads heavier than 18,000 pounds are also permitted in most States of the South Atlantic region, although Virginia, Georgia, and West Virginia have the 18,000-pound limit. In Ohio, axle loads up to 19,000 pounds are legal; all other States limit them to 18,000 pounds.

Since higher limits generally are allowed in the three regions mentioned, only a small portion of the heavy axle loads shown in these three areas are in excess of State laws, whereas in the other regions practically all axle weights over 18,000 pounds are in violation of the laws. When a comparison is made on the basis of conformity to State law, as will be discussed later, it will be seen that the rate of violation in all three of the eastern regions actually is very low. The low frequency of heavy axle loads in the Pacific region, which was shown in figure 16 to have the highest frequency of heavy gross loads, is noteworthy. Here again, the answer can be found in the State laws which encourage the distribution of the load to more axles.

The frequency of axle loads weighing 18,000, 20,000, and 22,000 pounds or more per 1,000 trucks and truck combinations on main rural roads in the summers of 1942–54 and in a prewar year is shown in figure 20. A most important fact indicated by the chart is the reversal in trend that began in 1951 and has continued each year. The frequency of axles weighing 18,000 pounds or more in 1950 was over seven times that in the prewar year, but from the 1950 high there was a consistent drop each year which amounted to 35 percent by 1954. Likewise, the frequency of 20,000-pound axles in 1950 was almost eight times that in the prewar year, but by 1954 the frequency of loads in this category was less than one-half of that in 1950. The number of axle loads of 22,000 pounds or more increased ninefold from the prewar year to 1950, but dropped more than 60 percent below that peak by 1954.

Load Distribution Improves

The rapid decrease in the frequency of heavy axle loads in the face of a stationary or slightly increasing number of heavy gross weights, as shown in figure 17, may at first appear illogical. However, the reason for the differences in the two charts was clearly brought out in the preceding discussion of figures 14–15. Many truckers are replacing their single-axle semitrailers with tandem-axle types, and the loads are therefore distributed over a larger number of axles. The net result of this equipment change is that many heavy loads, which formerly caused one or more axles of a vehicle to be overweight, are now transported in vehicles that are so designed that the loads are better distributed and no weight restriction is exceeded. Such changes, notwithstanding liberalization of the legal weight restrictions in some States, appear to be the main reason for the gratifying improvement in weight distribution that has occurred since 1950.

The number of axles weighing 18,000, 20,000, and 22,000 pounds or more for each 1,000 loaded and empty trucks and truck combinations on main rural roads in the summer of 1954 are given in table 12 (p. 248) for the main vehicle types, by census regions, and by the main geographic regions. Since no two-axle, single-unit trucks with single tires were found with axles weighing as much as 18,000 pounds, that type is not mentioned

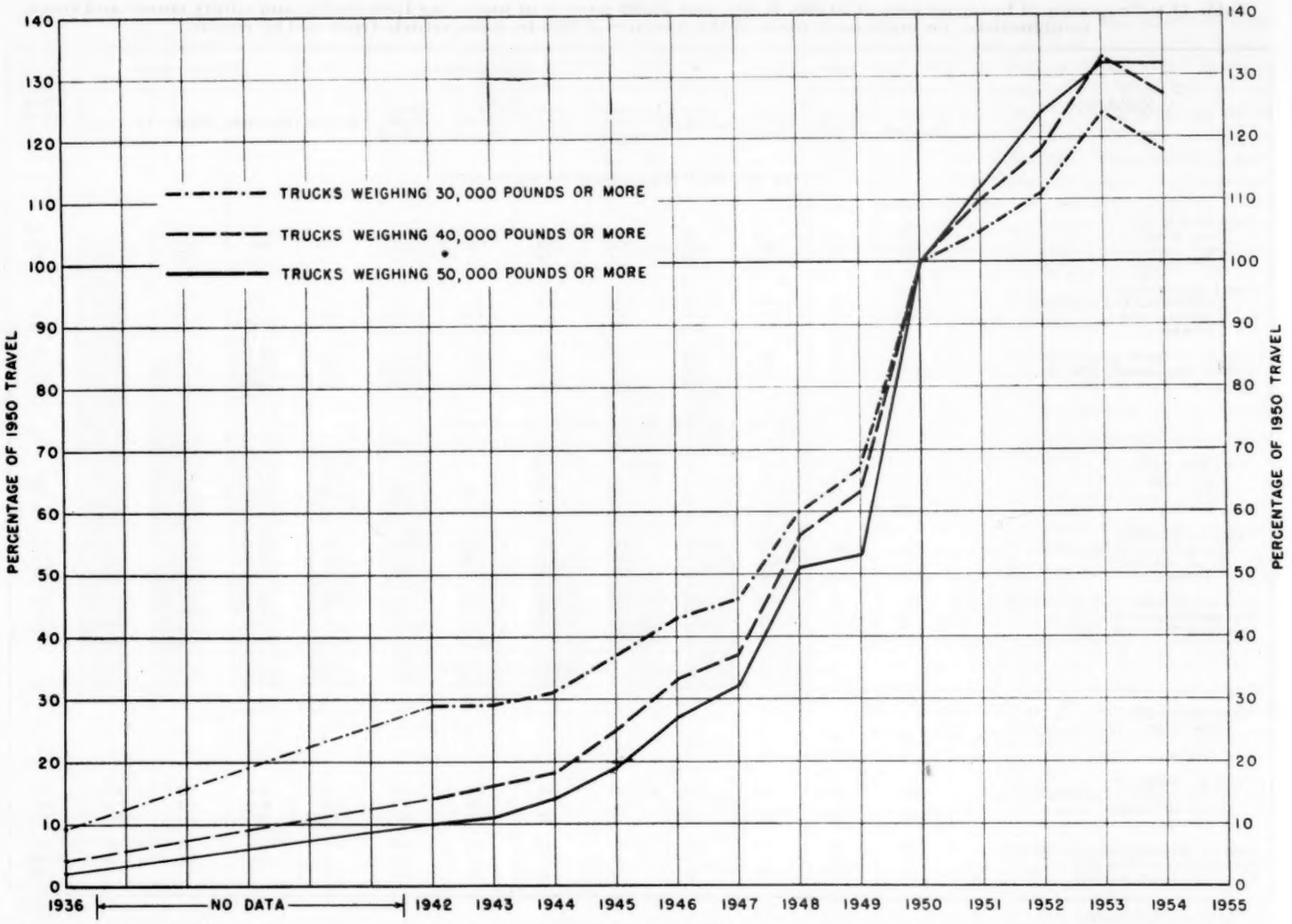

Figure 18.—Travel of trucks and truck combinations weighing 30,000, 40,000, and 50,000 pounds or more on main rural roads in the summers of 1942–54 and a prewar year, as a percentage of such travel in 1950.

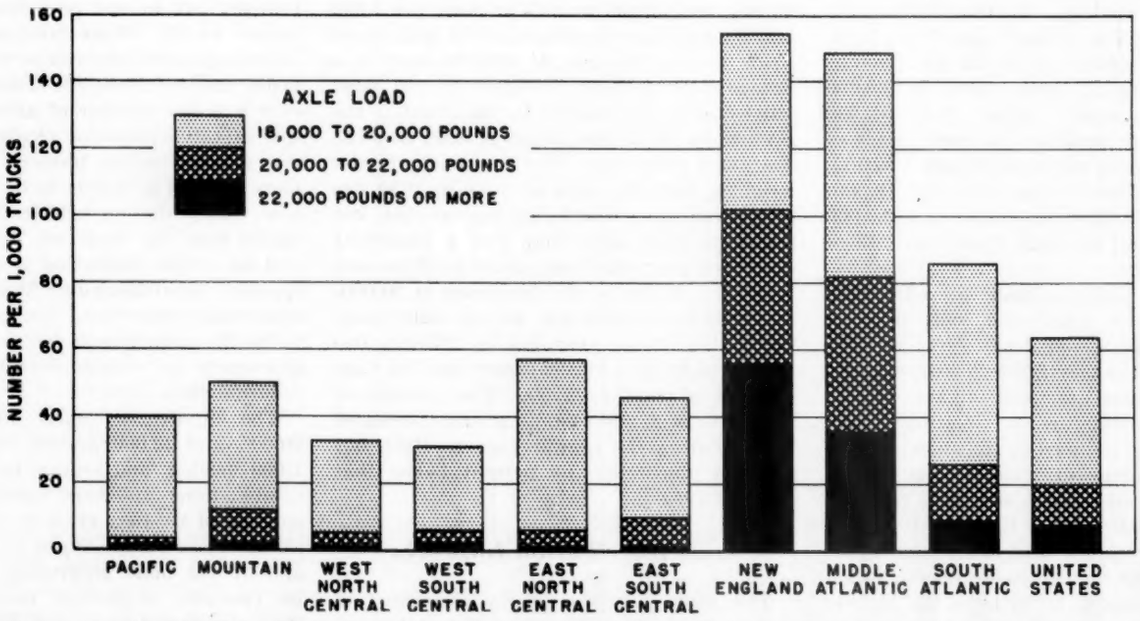

Figure 19.—Number of axle loads weighing 18,000, 20,000, and 22,000 pounds or more, per 1,000 trucks and truck combinations, on main rural roads in the summer of 1954, by regions.

in the table. The number of such vehicles counted is included, however, in obtaining the total frequency of all single-unit trucks and of all trucks and combinations.

The comparisons with 1953 and 1950 at the bottom of each section of the table show the trend of the frequency for each weight category. For instance, the number of axle loads weighing 18,000 pounds or more in 1954 compared with the previous year was downward in the New England, South Atlantic, East North Central, West South Central, and Pacific regions. In the remaining regions, the 1954 frequencies are above those for 1953, but with the exception of the New England region, are well below those of 1950. A comparison of the data in the other weight categories shows similar trends. For the United States as a whole, the trend is consistently downward for all axle weight levels. It is obvious that, for all regions and the three weight categories, it is the combination-type vehicles rather than the single-unit trucks that produce the greatest frequency of heavy axle loads.

In order to give a clearer picture of what is happening on the roads, figure 21 presents travel of vehicles with axles weighing 18,000, 20,000, and 22,000 pounds or more, in the summers of 1942–54 and a prewar year, as a

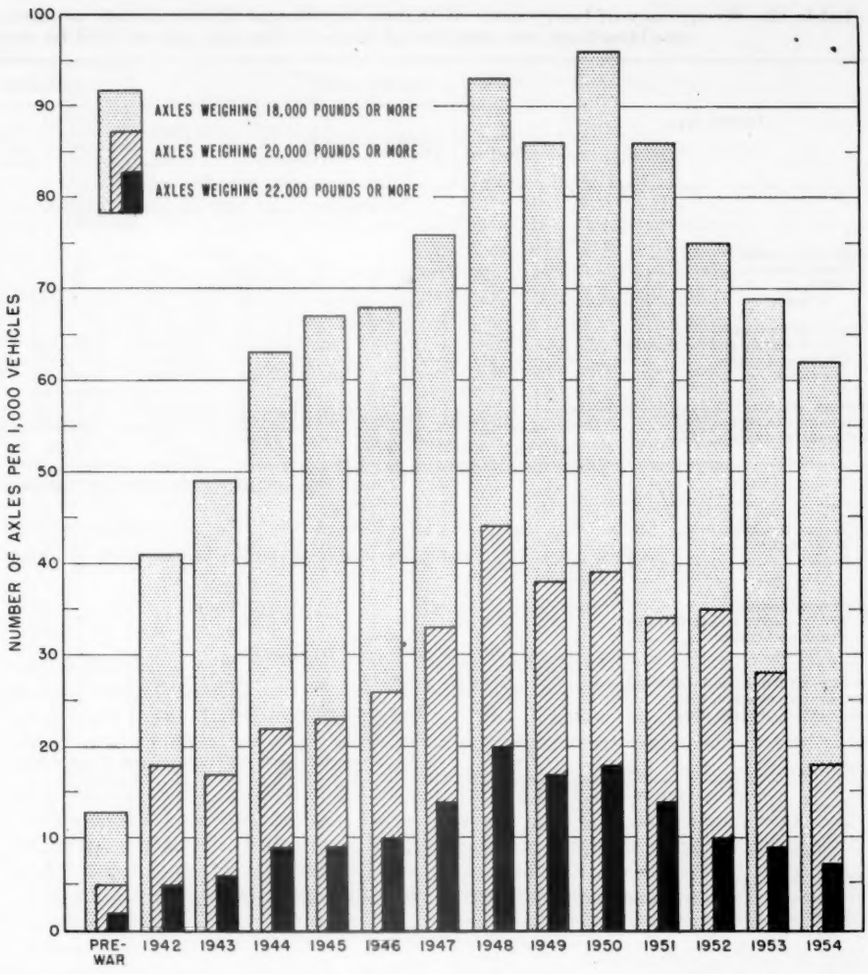

Figure 20* (Right).—*Number of axles weighing 18,000, 20,000, and 22,000 pounds or more, per 1,000 trucks and truck combinations, on main rural roads in the summers of 1942–54 and a prewar year.

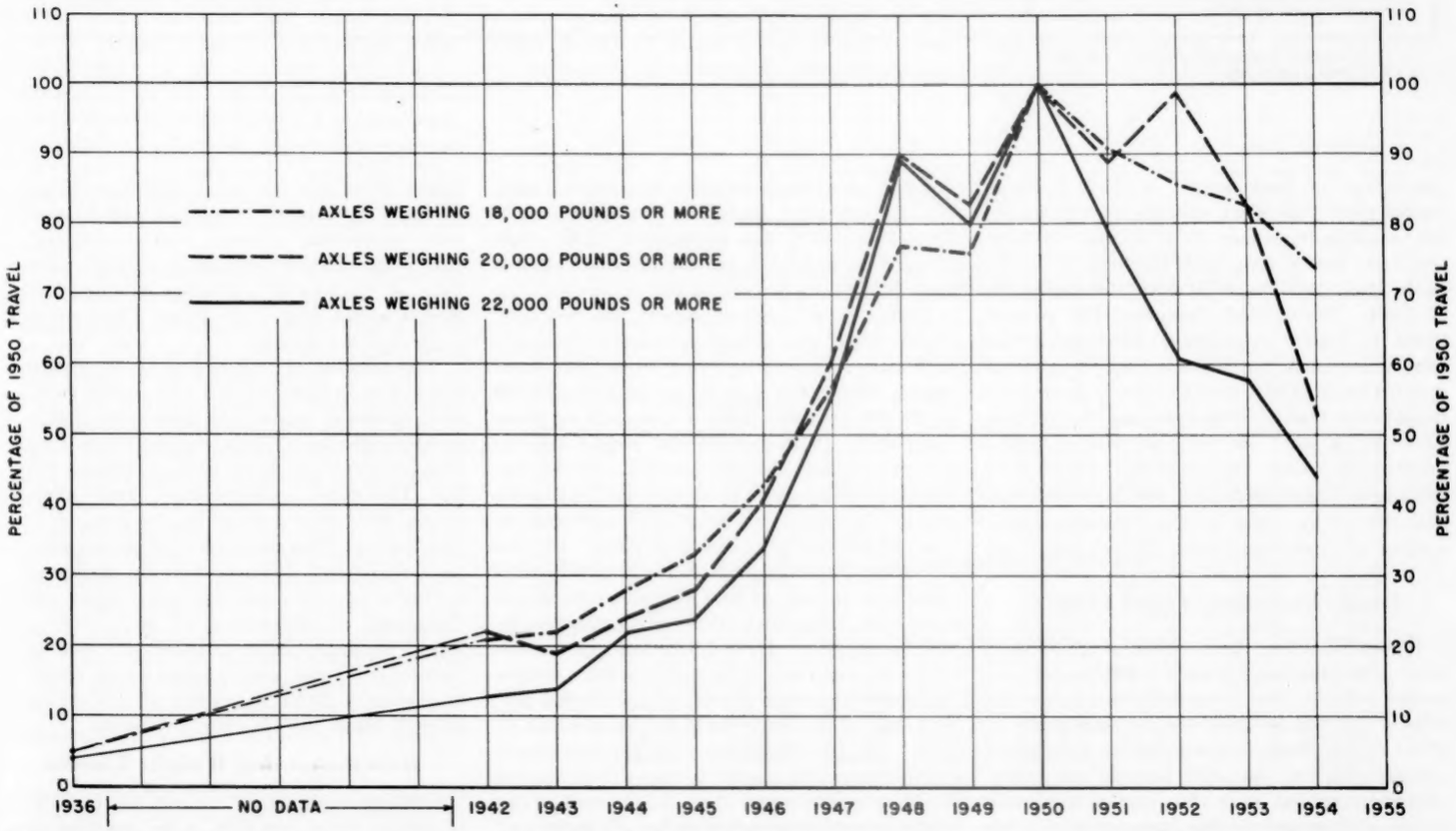

Figure 21.—Travel of vehicles with axles weighing 18,000, 20,000, and 22,000 pounds or more in the summers of 1942–54 and a prewar year, as a percentage of such travel in 1950.

Table 12.—Frequency of heavy axles of 18,000, 20,000, and 22,000 pounds or more, per 1,000 loaded and empty trucks and truck combinations, on main rural roads in the summer of 1954 by main vehicle types and by regions

Vehicle type	Eastern regions				Central regions					Western regions			United States average
	New England	Middle Atlantic	South Atlantic	Average	East North Central	East South Central	West North Central	West South Central	Average	Mountain	Pacific	Average	
NUMBER PER 1,000 WEIGHING 18,000 POUNDS OR MORE													
Single-unit trucks:													
2-axle, 6-tire	60	51	33	41	14	33	9	16	17	27	34	31	27
3-axle	311	73	77	104	9	21	8	45	16	70	33	46	57
Average	45	31	18	24	7	15	4	6	8	11	12	12	13
Truck combinations:													
Truck-tractor and semitrailer	465	341	247	307	115	164	83	98	111	154	94	119	176
Truck and trailer	------	(1)	------	(1)	229	------	111	44	178	242	118	155	160
Average	465	339	245	306	122	164	84	97	113	171	101	128	175
Average, all trucks and combinations	155	149	86	115	57	46	33	31	42	50	40	45	64
Comparative average, 1953	161	137	104	123	67	39	29	32	44	43	41	42	69
Comparative average, 1950	137	208	100	147	98	63	45	67	72	83	69	75	96
NUMBER PER 1,000 WEIGHING 20,000 POUNDS OR MORE													
Single-unit trucks:													
2-axle, 6-tire	41	29	11	22	1	7	2	4	3	7	1	4	10
3-axle	168	61	8	40	------	3	------	------	1	18	(2)	7	18
Average	29	18	5	12	(2)	3	2	1	1	3	(2)	1	5
Truck combinations:													
Truck-tractor and semitrailer	307	170	77	138	13	37	10	17	17	37	7	19	56
Truck and trailer	------	(1)	------	(1)	4	------	12	------	5	51	9	21	16
Average	306	169	76	137	12	37	10	17	16	40	8	20	54
Average, all trucks and combinations	102	82	26	53	6	10	5	6	6	12	3	7	20
Comparative average, 1953	93	68	44	58	11	6	3	7	9	9	3	4	28
Comparative average, 1950	82	131	38	80	22	19	12	23	19	35	16	24	39
NUMBER PER 1,000 WEIGHING 22,000 POUNDS OR MORE													
Single-unit trucks:													
2-axle, 6-tire	28	9	5	10	(2)	1	1	1	1	1	(2)	1	4
3-axle	101	36	2	23	------	3	------	------	1	2	------	1	9
Average	19	6	2	6	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	2
Truck combinations:													
Truck-tractor and semitrailer	158	85	26	63	2	3	1	5	2	9	3	5	23
Truck and trailer	------	------	------	------	------	------	12	------	3	------	3	2	2
Average	158	84	26	63	2	3	1	5	2	7	3	5	21
Average, all trucks and combinations	56	36	9	24	1	1	1	2	1	2	1	2	8
Comparative average, 1953	46	37	15	26	2	2	(2)	2	1	2	1	1	9
Comparative average, 1950	39	80	13	42	7	5	3	9	6	16	3	9	18

[1] Data omitted because of insufficient sample.
[2] Less than 5 per 10,000.

percentage of such travel in 1950. These curves show that when vehicle-mileage trends are considered, there is a steady upward trend in heavy axle-load frequencies in all years from 1936 to 1950 with the exception of 1949. Since 1950, however, the general trend in heavy axle-weight frequencies has been downward, notwithstanding the general upward trend in travel and in heavy gross-load frequencies that prevailed during the period. Thus by a shift to vehicles with a larger number of axles, the truckers are hauling more and bigger loads over the highways and still subjecting them to less frequent applications of heavy and destructive axle loads.

Loads Exceeding Legal Limits

Figure 22 shows the number of trucks and truck combinations for each 1,000 loaded and empty vehicles that exceeded the permissible axle, axle group, or gross-weight legal limits in effect in the State of observation during the summer of 1954. As might be expected, many vehicles exceeded more than one of the State limits and some of the larger vehicles or combinations had more than one axle loaded in excess of the limit. The data on which this chart is based were obtained by counting each vehicle only once, regardless of the number of ways in which it was overloaded. The chart gives an indication of the degree of compliance with State laws in each of the census regions.

In the New England region, for example, where there was a high frequency of heavy axle loads as shown by figure 19, vehicles were mostly within the legal limits of from 20,000 to 22,400 pounds. Only 4.1 percent of those sampled in 1954 violated the weight laws to any extent, and only 0.7 percent exceeded the limits by 20 percent or more. In the Pacific region, the legal axle-load limit conforms to the 18,000-pound recommendation of the American Association of State Highway Officials, and axle-group and gross-load limits are somewhat higher than those recommended by the Association. Here 7.8 percent of the vehicles exceeded one or more of the State weight restrictions to some extent, while only 0.2 percent exceeded those limits by 20 percent or more. In the Mountain region where maximum restrictions similar to those found in the Pacific region were in effect, 6.2 percent of the vehicles were overloaded to some extent and 0.7 percent by 20 percent or more.

Tolerances have been adopted in many States which are not taken into consideration in these figures. If a tolerance of 5 percent were universally allowed, almost one-half of the violators would be excused and the average rate of punishable violation in the United States would drop from about 5 percent to a little over 2.5 percent.

The number of trucks and truck combinations in each 1,000 loaded and empty vehicles that exceeded any of the axle, axle-group, or gross-weight legal limits in effect in the United States is shown in figure 23 for the years 1947–54. This chart is interesting in that, while it shows little if any trend in the frequency of overloads of 5 percent or less, there appears to be a real trend downward in the higher percentages of overload especially since 1950. Overloads of 50 percent or more were not found in appreciable numbers in 1952 and subsequent years, and the downward trend of overloads of 20 to 30 percent and of 30 to 50 percent after 1950 is very noticeable.

Recommended Weight Limits

Uniform regulations concerning maximum allowable gross weights, axle weights, and axle-group weights have been adopted as a policy by the American Association of State

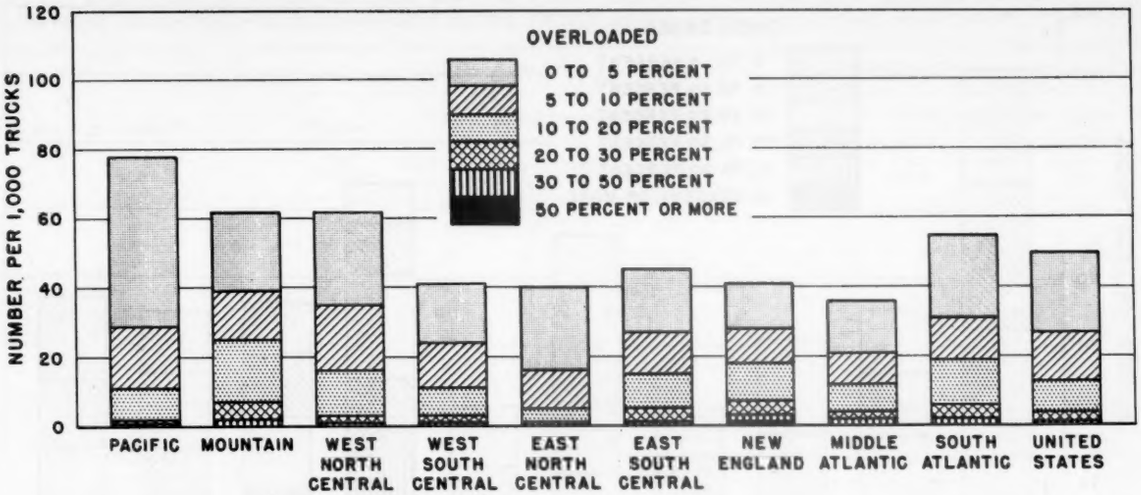

Figure 22.—Number of trucks and truck combinations, per 1,000 loaded and empty vehicles, that exceeded the permissible axle, axle-group, or gross-weight legal limits in effect in 1954, by regions.

Highway Officials and recommended to the State governments for adoption.[5] This policy recommends that no axle shall carry a load in excess of 18,000 pounds, and no group of axles shall carry a load in excess of amounts specified in a table of permissible weights based on the distance between the extremes of any group of axles. In preparing data concerning the number of vehicles exceeding the recommendations, each vehicle was counted only once regardless of the number of ways it might exceed these standards.

The number of vehicles in each 1,000 trucks and truck combinations that, in the summer of 1954, exceeded any of the weight limits recommended by the AASHO is shown by regions in figure 24. Since the data depicted in this chart are related to a common base, meaningful comparisons concerning regional heavy loading practices are apparent. This could not be readily determined from figure 22, which was based on different laws as discussed.

In the West North Central region where the State restrictions conform closely to the AASHO recommendations, both charts show that 62 vehicles out of each 1,000 were overloaded. That number is 24 percent above the national average when compared with State legal limits (fig. 22), but 16 percent below the national average with respect to the AASHO recommendations as shown in figure 24. In the Pacific region where State axle-group and gross-weight limits are somewhat more liberal than those recommended by the AASHO, 78 vehicles from each 1,000 sampled exceeded the State limits while 142 vehicles exceeded the AASHO recommendations. On the other hand, in the East South Central region, where State laws tend to be somewhat more restrictive than the recommendations, 45 vehicles in each 1,000 exceeded the State limits while only 42 such vehicles exceeded the recommendations.

Figure 24 also shows that the Pacific region leads all other areas in the frequency of heavy loads per thousand in excess of the AASHO recommendations, and is followed in descending order by New England (108) and the East North Central region (93). However, most of the overloads in the Pacific region were only a small percentage over the AASHO recommended limits. Here there were no loads as much as 50 percent over these limits and only 8 per thousand as much as 20 percent over. In the New England region, on the other hand, 50 vehicles per thousand were 20 percent or more over the AASHO recommended limits and 6 per thousand were over 50 percent or more.

The number of vehicles in each 1,000 trucks and truck combinations that exceeded any of the weight limits recommended by the AASHO is shown in figure 25 for the years 1947–54. The number of loads in excess of the recommendations to any degree vary from 28 percent in 1947 to 48 percent in 1954 above the similar frequencies for weights in excess of State laws shown in figure 23. Such a difference is to be expected for almost every year one or more States liberalize their motor-vehicle laws, thereby allowing more heavily loaded vehicles to pass legally over the roads. In New England, for instance,

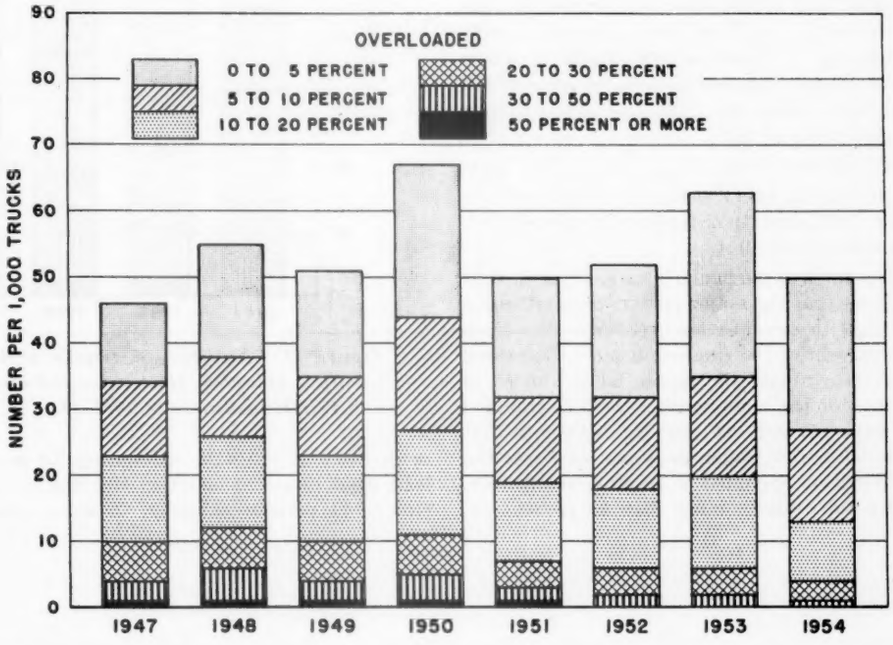

Figure 23.—Number of trucks and truck combinations, per 1,000 loaded and empty vehicles, that exceeded any of the permissible axle, axle-group, or gross-weight legal limits in effect in the summers of 1947–54.

[5] *Policy concerning maximum dimensions, weights, and speeds of motor vehicles to be operated over the highways of the United States*, adopted April 1, 1946, by the American Association of State Highway Officials; published by the Association in 1946.

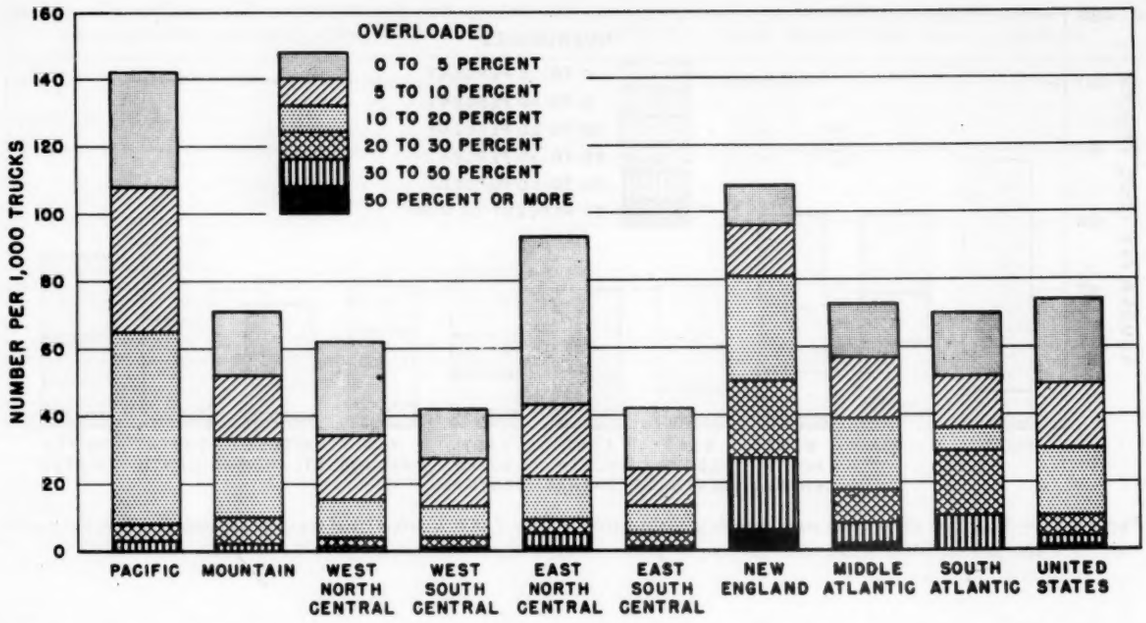

Figure 24.—Number of trucks and truck combinations, per 1,000 loaded and empty vehicles, that exceeded any of the weight limits recommended by the AASHO, summer of 1954.

the States have approved higher load limits of several types, such as maximum axle loads of 22,400 pounds. Such an axle load is almost 25 percent heavier than the maximum recommended by the AASHO and would account for a considerable portion of the difference between the number of such vehicles exceeding State laws and those exceeding AASHO recommendations. Little overall trend in vehicles overloaded can be detected from the chart although some reduction in the number of those overloaded to a high degree can be noted, as for instance the frequency of overloads of 30 to 50 percent and of 50 percent or more.

The number of trucks and truck combinations in each 1,000 loaded and empty vehicles in the summer of 1954 that exceeded the axle, axle-group, or gross-weight limits in effect in the States or recommended by the AASHO are given in table 13. These latest frequencies when compared with similar figures for 1950 and 1953 are found to be well below them in practically every instance. However, the 1948, 1951, and 1952 frequencies are slightly below those for 1954.

The table is particularly interesting in that it shows that the major portion of overloads is confined to combination-type vehicles. Only one percent of the single-unit trucks exceeded any State weight limitation, while almost 14 percent of the combinations were overloaded to some extent. Of the combinations that involved a full trailer (in some instances the combination included a tractor, semitrailer, and a full trailer), more than 25 percent exceeded one of the axle, axle-group, or gross-load legal limits in effect in the States, and almost 44 percent exceeded to some extent the maximum weight recommendations of the American Association of State Highway Officials.

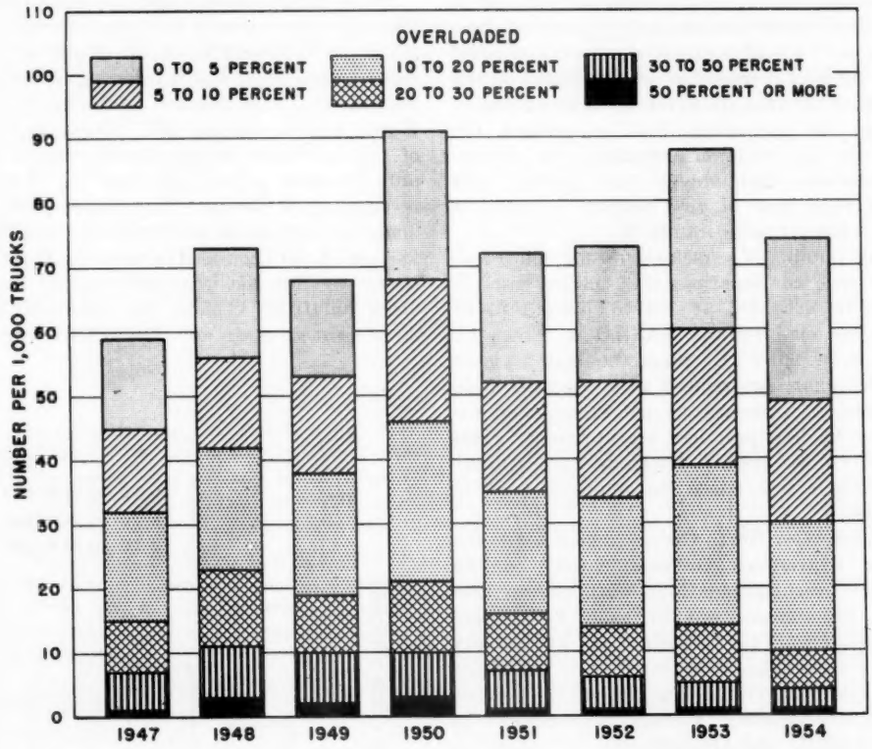

Figure 25.—Number of trucks and truck combinations, per 1,000 loaded and empty vehicles, that exceeded any of the weight limits recommended by the AASHO, summers of 1947–54.

Table 13.—Number of trucks and truck combinations, per 1,000 loaded and empty vehicles, that exceeded the axle, axle-group, or gross-weight limit in effect in the States or recommended by the AASHO in the summer of 1954 by main vehicle types and by regions

Region and type of vehicle	Vehicles exceeding State legal limits						Vehicles exceeding AASHO recommendations					
	Number per 1,000 overloaded	Number per 1,000 overloaded more than—					Number per 1,000 overloaded	Number per 1,000 overloaded more than—				
		5 percent	10 percent	20 percent	30 percent	50 percent		5 percent	10 percent	20 percent	30 percent	50 percent
New England:												
2-axle, 6-tire	10	6	4	2	1	1	60	50	44	32	19	10
3-axle	153	95	89	70	31		211	198	186	104	82	12
Average, single-unit trucks	12	7	6	4	2	(1)	39	34	30	20	13	6
Truck-tractor and semitrailer	123	84	51	15	5	1	302	268	223	134	66	7
Truck and trailer												
Average, truck combinations	123	84	51	15	5	1	302	268	223	134	66	7
Average, all trucks and combinations	41	28	18	7	3	1	108	96	81	50	27	6
Middle Atlantic:												
2-axle, 6-tire	21	14	5	1	1		52	45	31	15	5	1
3-axle	25	22	22	19	16	9	26	23	23	20	15	9
Average, single-unit trucks	13	8	4	1	1	(1)	30	26	18	9	3	1
Truck-tractor and semitrailer	74	41	25	8	3	(1)	144	107	72	33	15	4
Truck and trailer	77	77					85	81	81	77		
Average, truck combinations	74	41	25	8	3	(1)	144	106	72	33	15	4
Average, all trucks and combinations	36	21	12	4	2	(1)	73	57	39	18	8	2
South Atlantic:												
2-axle, 6-tire	18	10	5	3	1	(1)	28	18	11	6	2	(1)
3-axle	60	33	11	2			75	47	36	5	1	1
Average, single-unit trucks	11	6	3	1	1	(1)	15	10	6	3	1	(1)
Truck-tractor and semitrailer	159	90	57	19	5	1	199	147	105	42	14	1
Truck and trailer												
Average, truck combinations	158	89	56	19	5	1	198	146	104	42	14	1
Average, all trucks and combinations	55	31	19	6	2	(1)	70	51	36	29	10	(1)
East North Central:												
2-axle, 6-tire	7	5					8	6	(1)			
3-axle	21	13	7				51	23				
Average, single-unit trucks	4	3	(1)				6	3	(1)			
Truck-tractor and semitrailer	86	32	12	3	2	(1)	200	93	51	20	11	3
Truck and trailer	96	68					291	125	48	18		
Average, truck combinations	86	34	11	3	2	(1)	205	95	51	20	10	3
Average, all trucks and combinations	40	16	5	1	1	(1)	93	43	22	9	5	1
East South Central:												
2-axle, 6-tire	34	23	12	6	1	1	33	22	12	6	1	1
3-axle	32	14	6	5			32	14	6	5	4	
Average, single-unit trucks	16	10	6	3	1	(1)	16	10	6	3	1	(1)
Truck-tractor and semitrailer	158	91	49	13	3	(1)	142	79	43	11	2	(1)
Truck and trailer												
Average, truck combinations	158	91	49	13	3	(1)	141	79	43	11	2	(1)
Average, all trucks and combinations	45	27	15	5	1	(1)	42	24	13	5	1	(1)
West North Central:												
2-axle, 6-tire	9	4	2	1			9	4	2	1		
3-axle	42	21	10	4			15	5	4	4		
Average, single-unit trucks	6	3	1	(1)			5	2	1	(1)		
Truck-tractor and semitrailer	167	95	42	6	2		169	93	41	9	2	
Truck and trailer	136	66	58	57	57		129	64	58	57	57	
Average, truck combinations	166	93	43	8	4		167	92	42	11	4	
Average, all trucks and combinations	62	35	16	3	1		62	34	15	4	1	
West South Central:												
2-axle, 6-tire	16	11	6	1			16	10	5	1		
3-axle	54	45	9	9			54	45	9	9		
Average, single-unit trucks	6	4	2	1			6	4	2	(1)		
Truck-tractor and semitrailer	139	80	36	10	3	(1)	141	90	43	12	4	(1)
Truck and trailer	35	35	35				70	70	70	70		
Average, truck combinations	137	80	36	10	3	(1)	139	89	43	13	4	(1)
Average, all trucks and combinations	41	24	11	3	1	(1)	42	27	13	4	1	(1)
Mountain:												
2-axle, 6-tire	27	14	6	2	(1)		27	14	6	2	(1)	
3-axle	94	63	35	8	3		89	69	37	12	3	
Average, single-unit trucks	12	7	3	1	(1)		12	7	3	1	(1)	
Truck-tractor and semitrailer	207	136	88	25	6	1	235	172	111	37	10	1
Truck and trailer	256	158	103	16	6		333	260	174	30	6	
Average, truck combinations	217	140	91	24	6	1	255	189	124	35	9	1
Average, all trucks and combinations	62	39	25	7	2	(1)	71	52	33	10	2	(1)
Pacific:												
2-axle, 6-tire	34	25	12	(1)			34	26	12	(1)		
3-axle	134	47	20	7	(1)		148	76	20	13		
Average, single-unit trucks	18	10	5	(1)	(1)		19	12	5	1		
Truck-tractor and semitrailer	132	47	18	7	2		302	235	146	22	9	(1)
Truck and trailer	393	129	38	5	2		670	508	315	31	12	
Average, truck combinations	208	71	24	6	2		409	314	195	25	10	(1)
Average, all trucks and combinations	78	29	11	2	1		142	108	65	8	3	(1)
United States Average:												
2-axle, 6-tire	19	12	5	2	1	(1)	27	19	12	5	2	1
3-axle	65	34	18	9	3	1	74	47	27	12	6	2
Average, single-unit trucks	10	6	3	1	(1)	(1)	14	10	6	3	1	(1)
Truck-tractor and semitrailer	128	68	36	10	3	(1)	188	121	75	27	11	2
Truck and trailer	256	109	42	10	6		437	310	191	32	11	
Average, truck combinations	136	71	36	10	3	(1)	204	133	82	27	11	2
Average, all trucks and combinations	50	27	13	4	1	(1)	74	49	30	10	4	1

[1] Less than 5 per 10,000.

New Publications

General Location of the National System of Interstate Highways, Including All Additional Routes at Urban Areas Designated in September 1955 is the title of a new publication issued by the Bureau of Public Roads. The pamphlet contains a small-scale map of the United States showing the general location of the National System of Interstate Highways and individual maps showing the locations of routes of the system into, through, and around 102 urban areas. The urban maps show only the city outlines and the general locations of the Interstate system; detailed final locations will be determined as projects are advanced by the States for construction. The pamphlet contains no text other than the certificate of approval.

The publication is not distributed free by the Bureau. Copies may be purchased, at 55 cents a copy, from the Superintendent of Documents, U. S. Government Printing Office, Washington 25. D. C.

The National System of Interstate Highways, authorized by the Congress in 1944 with a limitation of 40,000 miles, is made up of the main highways of the Nation, connecting the principal metropolitan areas, cities, and industrial centers, and serving the national defense. It is a part of the larger Federal-aid primary system. The main network of the Interstate system, totaling 37,700 miles, was selected by joint action of the State highway departments and approved by the Bureau of Public Roads on August 2, 1947. The additional urban routes, totaling 2,300 miles, were recommended by the States and approved by the Bureau on September 15, 1955.

The urban maps in the pamphlet show without differentiation the general locations of both the newly added routes and the routes through the urban areas previously approved. Maps are not included for urban areas where new routes were not added. Many such urban areas are served by previously approved interstate routes passing through or around them, as indicated by the U. S. map of the system included in the pamphlet.

Opportunities in the Bureau of Public Roads for Young Engineers was recently published by the Bureau, in its third edition. This illustrated, 16-page pamphlet is intended to provide information for college students interested in careers in highway or highway bridge engineering in the Bureau of Public Roads. The publication briefly describes the organization, operations, and history of the Bureau, and explains in detail the 3-year, on-the-job training program offered by the Bureau to selected civil engineering school graduates.

The Bureau's free distribution of the pamphlet is restricted to use in recruitment for its training program. Others who are interested in the publication may purchase it from the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C., at 25 cents a copy.

PUBLIC ROADS: World Traveler

PUBLIC ROADS magazine is not only one of the oldest continuously published periodicals of the United States Government; it is also probably one of the most widely traveled. A recent review of mailing lists shows that each bimonthly edition of more than 5,000 copies carries the message of the Bureau of Public Roads research work throughout the United States and to 80 countries around the world.

The Bureau of Public Roads distributes 817 copies of PUBLIC ROADS magazine to its own personnel, and 1,464 copies are sent to the State highway departments in furtherance of the cooperative Federal-State highway program. In addition, 446 copies go to other Federal and State agencies and to county and local rural and urban government highway departments, 161 copies are sent to university libraries and instructors in highway engineering, and 138 to engineering and trade associations and publications. The Bureau's free distribution overseas reaches 50 foreign countries with 286 copies, mostly to national government highway agencies.

In addition to the Bureau's distribution, the Government Printing Office, in its program of supplying representative libraries with Government publications, distributes PUBLIC ROADS to 373 depository libraries across the Nation. The United States Information Agency uses 87 copies in its information centers in 41 foreign countries.

Free distribution of the magazine by the Bureau of Public Roads is limited to public officials actually engaged in planning or constructing highways and to instructors of highway engineering. There are at present no vacancies on the free list, which is limited to a specific maximum by regulation. PUBLIC ROADS is sold by the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C., at $1.00 per year (25 cents additional for foreign mailing). Orders for subscriptions are NOT received by the Bureau of Public Roads.

That PUBLIC ROADS magazine is considered worthwhile reading is indicated by the paid subscription list, numbering 1,018 in the United States and 523 in 60 foreign countries. In somewhat less than 2 years (December 1953 to October 1955), subscriptions in the United States have increased 29 percent and foreign paid subscriptions have practically doubled in number.

Geographically, the total (free and paid) PUBLIC ROADS distribution is remarkably widespread. It goes to every State, ranging in number from 15 copies for Vermont and 19 for Delaware to 315 for New York and 428 for California. Twenty-three States receive up to 50 copies each; 13 States are in the 51 to 100 copy range; over 100 copies go to each of 12 States and the District of Columbia. Four U. S. Territories are on the mailing lists.

In the Western Hemisphere, Canada and Mexico take 97 copies of the magazine; 8 countries in Central America and the Carribean area receive 22 copies; and 8 South American nations get 90 copies.

In Europe, 318 copies of the magazine are distributed among 22 different countries.

Dividing Africa on latitude 10° N., 6 North African countries receive 18 copies of PUBLIC ROADS; 10 Central and South African countries get 56 copies. On the Asian continent, 26 copies of the magazine go to 7 countries in the Middle East (longitude 30°–60° E.); 6 nations in Central Asia (longitude 60°–100° E.) receive 51 copies; 7 countries in the Far East (east of longitude 100° E.) get 126 copies. Four countries of Oceania receive 92 copies.

The 896 copies going to 80 different countries account for 17 percent of the total PUBLIC ROADS distribution of 5,313 copies.

The paid circulation of 1,541 copies amounts to 29 percent of the total distribution, which seems surprisingly good for a government periodical in the technical research field.

PUBLIC ROADS is indeed a world traveler and, judging from the proportion and rate of increase of subscription sales, it must be a welcome one.

As a matter that may be of interest to some, the countries receiving PUBLIC ROADS are listed below. The magazine also goes, of course, to all 48 States, the District of Columbia, Alaska, Canal Zone, Hawaii, and Puerto Rico.

Western Hemisphere.—Argentina, Bolivia, Brazil, British West Indies, Canada, Chile, Colombia, Costa Rica, Cuba, Ecuador, Guatemala, Honduras, Mexico, Nicaragua, Panama, Peru, Uruguay, and Venezuela.

Europe.—Austria, Belgium, Czechoslovakia, Denmark, England, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Netherlands, Norway, Portugal, Scotland, Spain, Sweden, Switzerland, Union of Soviet Socialistic Republics, and Yugoslavia.

Africa.—Algeria, Angola, Belgian Congo, Egypt, Ethiopia, Federation of Rhodesia and Nyasaland, French West Africa, Gold Coast, Kenya, Liberia, Morocco, Mozambique, Nigeria, Tanganyika, Tunisia, and Union of South Africa.

Asia.—Afghanistan, Burma, Ceylon, China (Taiwan), Hong Kong, India, Iran, Iraq, Israel, Japan, Jordan, Lebanon, Malaya, Pakistan, Philippines, Singapore, Syria, Thailand, Turkey, and Kazakh Soviet Socialistic Republic (U. S. S. R.).

Oceania.—Australia, Indonesia, New Zealand, and Papua.

U. S. GOVERNMENT PRINTING OFFICE: 1955

A list of the more important articles in PUBLIC ROADS may be obtained upon request addressed to Bureau of Public Roads, Washington 25, D. C.

PUBLICATIONS of the Bureau of Public Roads

The following publications are sold by the Superintendent of Documents, Government Printing Office, Washington 25, D. C. Orders should be sent direct to the Superintendent of Documents. Prepayment is required.

ANNUAL REPORTS

Work of the Public Roads Administration:
1941, 15 cents. 1948, 20 cents.
1942, 10 cents. 1949, 25 cents.

Public Roads Administration Annual Reports:
1943; 1944; 1945; 1946; 1947.
(*Free from Bureau of Public Roads*)

Annual Reports of the Bureau of Public Roads:
1950, 25 cents. 1952, 25 cents. 1954 (out of print).
1951, 35 cents. 1953, 25 cents.

PUBLICATIONS

Bibliography of Highway Planning Reports (1950). 30 cents.

Braking Performance of Motor Vehicles (1954). 55 cents.

Construction of Private Driveways, No. 272MP (1937). 15 cents.

Criteria for Prestressed Concrete Bridges (1954). 15 cents.

Design Capacity Charts for Signalized Street and Highway Intersections (reprint from PUBLIC ROADS, Feb. 1951). 25 cents.

Electrical Equipment on Movable Bridges, No. 265T (1931). 40 cents.

Factual Discussion of Motortruck Operation, Regulation, and Taxation (1951). 30 cents.

Federal Legislation and Regulations Relating to Highway Construction (1948). Out of print.

Financing of Highways by Counties and Local Rural Governments: 1931–41, 45 cents; 1942–51, 75 cents.

General Location of the National System of Interstate Highways, Including All Additional Routes at Urban Areas Designated in September 1955. 55 cents.

Highway Bond Calculations (1936). 10 cents.

Highway Bridge Location No. 1486D (1927). 15 cents.

Highway Capacity Manual (1950). $1.00.

Highway Needs of the National Defense, House Document No. 249 (1949). 50 cents.

Highway Practice in the United States of America (1949). 75 cents.

Highway Statistics (annual):
1945 (out of print). 1948, 65 cents. 1951, 60 cents.
1946, 50 cents. 1949, 55 cents. 1952, 75 cents.
1947, 45 cents. 1950 (out of print). 1953, $1.00.

Highway Statistics, Summary to 1945. 40 cents.

Highways in the United States, *nontechnical* (1954). 20 cents.

Highways of History (1939). 25 cents.

Identification of Rock Types (1950). Out of print.

Interregional Highways, House Document No. 379 (1944). 75 cents.

Legal Aspects of Controlling Highway Access (1945). 15 cents.

Local Rural Road Problem (1950). 20 cents.

Manual on Uniform Traffic Control Devices for Streets and Highways (1948) (*including 1954 revisions supplement*). $1.00.
Revisions to the Manual on Uniform Traffic Control Devices for Streets and Highways (1954). *Separate*, 15 cents.

Mathematical Theory of Vibration in Suspension Bridges (1950). $1.25.

Model Traffic Ordinance (revised 1953). 20 cents.

PUBLICATIONS (Continued)

Needs of the Highway Systems, 1955–84, House Document No. 120 (1955). 15 cents.

Opportunities in the Bureau of Public Roads for Young Engineers (1955). 25 cents.

Principles of Highway Construction as Applied to Airports, Flight Strips, and Other Landing Areas for Aircraft (1943). $2.00.

Progress and Feasibility of Toll Roads and Their Relation to the Federal-Aid Program, House Document No. 139 (1955). 15 cents.

Public Control of Highway Access and Roadside Development (1947). 35 cents.

Public Land Acquisition for Highway Purposes (1943). 10 cents.

Public Utility Relocation Incident to Highway Improvement, House Document No. 127 (1955). 25 cents.

Results of Physical Tests of Road-Building Aggregate (1953). $1.00.

Roadside Improvement, No. 191MP (1934). 10 cents.

Selected Bibliography on Highway Finance (1951). 60 cents.

Specifications for Construction of Roads and Bridges in National Forests and National Parks, FP–41 (1948). $1.50.

Standard Plans for Highway Bridge Superstructures (1953). $1.25.

Taxation of Motor Vehicles in 1932. 35 cents.

Tire Wear and Tire Failures on Various Road Surfaces (1943). 10 cents.

Transition Curves for Highways (1940). $1.75.

MAPS

State Transportation Map series (available for 39 States). Uniform sheets 26 by 36 inches, scale 1 inch equals 4 miles. Shows in colors Federal-aid and State highways with surface types, principal connecting roads, railroads, airports, waterways, National and State forests, parks, and other reservations. Prices and number of sheets for each State vary—see Superintendent of Documents price list 53.

United States System of Numbered Highways together with the Federal-Aid Highway System (also shows in color National forests, parks, and other reservations). 5 by 7 feet (in 2 sheets), scale 1 inch equals 37 miles. $1.25.

United States System of Numbered Highways. 28 by 42 inches, scale 1 inch equals 78 miles. 20 cents.

Single copies of the following publications are available to highway engineers and administrators for official use, and may be obtained by those so qualified upon request addressed to the Bureau of Public Roads. They are not sold by the Superintendent of Documents.

Bibliography on Automobile Parking in the United States (1946).

Bibliography on Highway Lighting (1937).

Bibliography on Highway Safety (1938)

Bibliography on Land Acquisition for Public Roads (1947).

Bibliography on Roadside Control (1949).

Express Highways in the United States: a Bibliography (1945).

Indexes to PUBLIC ROADS, volumes 17–19 and 23.

Title Sheets for PUBLIC ROADS, volumes 24–27.

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DEPARTMENT OF COMMERCE - BUREAU OF PUBLIC ROADS

STATUS OF FEDERAL-AID HIGHWAY PROGRAM

AS OF OCTOBER 31, 1955

(Thousand Dollars)

STATE	UNPROGRAMMED BALANCES	ACTIVE PROGRAM											
		PROGRAMMED ONLY			PLANS APPROVED, CONSTRUCTION NOT STARTED			CONSTRUCTION UNDER WAY			TOTAL		
		Total Cost	Federal Funds	Miles	Total Cost	Federal Funds	Miles	Total Cost	Federal Funds	Miles	Total Cost	Federal Funds	Miles
Alabama	$19,913	$13,218	$6,731	324.0	$6,035	$3,339	57.0	$38,210	$19,646	597.8	$57,463	$29,716	978.8
Arizona	8,961	4,884	3,616	93.9	1,565	1,176	29.7	11,048	8,071	184.4	17,497	12,863	308.0
Arkansas	15,227	9,565	5,129	315.4	7,121	3,564	82.9	19,525	9,866	433.6	36,211	18,559	831.9
California	18,293	43,690	23,703	222.9	15,081	8,160	27.4	129,735	66,046	286.9	188,506	97,909	537.2
Colorado	18,123	10,353	5,864	165.8	2,448	1,417	20.1	17,676	9,595	146.0	30,477	16,876	331.9
Connecticut	23,204	840	420	3.7	757	374	3.2	8,135	4,045	11.8	9,732	4,839	18.7
Delaware	6,850	1,723	868	10.2	1,207	621	20.5	5,911	3,299	14.8	8,841	4,788	45.5
Florida	17,279	14,196	7,453	288.3	12,815	6,611	83.6	25,520	12,808	236.9	52,531	26,872	608.8
Georgia	26,351	24,616	12,417	527.2	7,622	3,399	64.0	39,780	18,862	682.6	72,018	34,678	1,273.8
Idaho	10,039	3,857	2,488	77.4	4,025	2,686	42.6	9,547	6,194	152.4	17,429	11,368	272.4
Illinois	30,895	39,413	22,567	378.0	20,056	11,049	43.2	86,210	45,717	575.7	145,679	79,333	996.9
Indiana	33,164	18,745	9,561	90.7	13,346	7,716	54.0	37,239	19,890	100.2	69,330	37,167	244.9
Iowa	18,375	17,730	9,630	513.5	5,831	2,974	83.0	23,471	12,669	889.1	47,032	25,273	1,485.6
Kansas	19,078	10,518	5,262	657.5	2,613	1,400	65.7	22,284	11,339	918.9	35,415	18,001	1,642.1
Kentucky	15,776	11,513	6,298	100.2	3,197	1,932	10.4	40,337	20,720	635.0	55,047	28,950	745.6
Louisiana	13,648	15,019	7,509	169.7	5,451	2,725	32.3	42,974	20,368	510.5	63,444	30,602	712.5
Maine	8,018	9,198	4,895	65.0	543	272	5.9	11,385	5,878	76.0	21,126	11,045	146.9
Maryland	9,755	28,618	14,540	72.9	5,865	2,821	4.8	14,069	7,362	86.6	48,552	24,723	164.3
Massachusetts	27,423	8,354	4,167	24.9	1,806	903		43,725	20,751	46.9	53,885	25,821	71.8
Michigan	20,031	48,882	25,674	534.4	18,783	9,790	71.2	47,124	23,742	545.6	114,789	59,206	1,151.2
Minnesota	23,207	5,661	2,962	332.5	3,282	1,656	128.3	31,147	16,606	666.7	40,090	21,224	1,127.5
Mississippi	16,556	7,313	3,591	249.0	4,119	2,243	62.2	28,512	14,686	740.8	39,944	20,520	1,052.0
Missouri	18,878	25,810	13,233	1,123.0	8,783	5,280	8.0	72,387	37,593	1,156.8	106,980	56,106	2,287.8
Montana	18,699	9,610	6,035	187.7	5,594	3,235	90.5	21,918	13,766	370.0	37,122	23,036	648.2
Nebraska	17,295	18,322	9,572	841.4	6,404	2,919	59.2	27,252	15,241	770.0	51,978	27,732	1,670.6
Nevada	14,811	3,910	3,307	60.6	666	557	13.3	5,140	4,316	92.1	9,716	8,180	166.0
New Hampshire	7,421	2,225	1,120	14.6	158	79	.8	7,196	3,725	44.5	9,579	4,924	59.9
New Jersey	25,817	13,356	6,146	57.5	3,556	1,786	4.7	30,447	14,209	53.0	47,359	22,141	115.2
New Mexico	11,629	3,584	2,317	54.0	2,795	1,827	39.7	8,696	5,759	170.9	15,075	9,903	264.6
New York	66,564	48,717	25,196	71.4	8,556	4,375	21.6	228,815	105,411	333.8	286,088	134,982	426.8
North Carolina	24,428	15,825	7,880	187.3	4,108	1,979	47.9	41,729	20,803	590.3	61,662	30,662	825.5
North Dakota	12,270	5,224	2,689	808.3	4,260	2,168	435.1	11,137	5,597	651.6	20,621	10,454	1,895.0
Ohio	38,682	56,819	29,284	171.1	7,053	3,447	25.5	66,129	31,933	103.4	130,001	64,664	300.0
Oklahoma	19,574	17,111	8,940	337.5	14,301	7,541	141.2	30,342	15,891	359.7	61,754	32,372	838.4
Oregon	8,056	11,671	6,708	108.0	4,366	2,761	42.7	16,175	10,029	159.0	32,212	19,498	309.7
Pennsylvania	40,814	56,550	28,334	76.7	20,779	10,761	44.0	82,980	41,545	268.2	160,309	80,640	388.9
Rhode Island	2,265	10,189	5,414	18.6	946	473	1.5	14,076	7,051	29.1	25,211	12,938	49.2
South Carolina	16,427	11,912	6,390	329.6	1,911	1,163	18.3	20,707	10,759	317.5	34,530	18,312	665.4
South Dakota	12,978	8,850	5,097	382.4	3,534	2,057	124.4	11,316	6,523	536.5	23,700	13,677	1,043.3
Tennessee	23,999	18,109	9,013	247.2	8,087	4,043	88.8	37,310	16,870	358.5	63,506	29,926	694.5
Texas	44,982	30,077	15,867	550.4	18,269	9,709	167.3	88,662	46,954	1,262.5	137,008	72,530	1,980.2
Utah	7,570	5,798	4,329	74.0	1,698	1,181	5.1	11,570	8,833	195.1	19,066	14,343	274.2
Vermont	5,632	2,025	1,019	8.9	263	132	7.0	8,965	4,699	86.5	11,253	5,850	102.4
Virginia	21,038	15,856	8,222	256.7	4,536	2,374	25.9	24,801	12,066	281.9	45,193	22,662	564.5
Washington	14,291	15,399	8,475	154.5	3,863	2,019	72.2	23,859	12,733	125.8	43,121	23,227	352.5
West Virginia	18,402	8,891	4,547	37.3	2,757	1,393	7.8	17,575	8,824	98.6	29,223	14,764	143.7
Wisconsin	22,776	12,575	6,454	125.2	2,339	1,176	7.1	47,568	23,892	487.0	62,482	31,522	619.3
Wyoming	8,284	2,474	1,593	33.1	1,242	799	18.4	13,018	8,547	273.5	16,734	10,939	325.0
Hawaii	5,329	2,827	1,414	5.7	3,177	1,571	2.9	5,050	2,245	11.5	11,054	5,230	20.1
District of Columbia	10,130	4,437	2,218	4.1	1,206	602	2.4	8,175	3,616	1.3	13,818	6,436	7.8
Puerto Rico	12,817	3,443	1,668	21.0				16,591	7,602	57.6	20,034	9,270	78.6
TOTAL	952,024	789,502	417,826	11,564.9	288,775	154,235	2,515.3	1,733,150	885,192	17,785.4	2,811,427	1,457,253	31,865.6

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